Infrastructure, regulatory and financial information for the antenna siting community.

ABOVE GROUND LEVEL

agl™

www.agl-mag.com

FEBRUARY / MARCH 2006

The Meter Is Not Enough

RF Measurement Troubleshooting

Raise the Tower

with Safety First, Not Last

AGL (Above Ground Level) Magazine
P.O. Box 620189
Littleton, CO 80162-9950

ADDRESS SERVICE REQUESTED

PRSRT STD
U.S. Postage
PAID
Permit #45
Liberty, MO

#BYNTUDX ******AUTO**3-DIGIT 857
#0381539# 372

BARRY MISHKIND
EDITOR
RADIO GUIDE
2033 S AUGUSTA PL
TUCSON AZ 85710-7305

The official magazine for PCIA— The Wireless Infrastructure Association

A BIBY PUBLISHING, L.L.C. PUBLICATION

INSURANCE PROGRAM For Tower Owners

Atlantic Risk Management Corporation is pleased to offer an insurance program that will meet your unique needs. This program is endorsed by PCIA, The Wireless Infrastructure Association.

Our competitively priced program includes:

Property
Self-supporting, Guyed, or Monopole Towers
Support Equipment
Shelters and Fencing

General Liability
1,000,000 Occurance
2,000,000 Aggregate

Business Auto

Workers Compensation

Umbrella

Bonding

Other Coverages Available
Professional Liability
Directors and Officers Liability

Atlantic Risk Management CORPORATION

PCIA™ The Wireless Infrastructure Association

David Saul
Email: dsaul@atlanticrisk.com
Call: (410) 480-4413
Fax: (410) 465-0759

THE HARTFORD

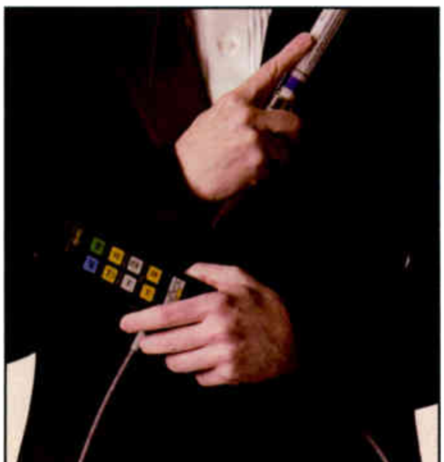
32

42

Features

Departments

10



on the cover

A 'bonded' survey agent probes an RF site to reveal emitters that might exceed FCC limits *(see page 20)*.

Photography by Thomas Gibson
Art and design by Scott Dolash
Equipment courtesy of Narda STS

AGL (ABOVE GROUND LEVEL) is published by Biby Publishing LLC, P.O. Box 284, Waterford, VA 20197, and is mailed free to qualified individuals.
POSTMASTER: Send address change to *AGL* Circulation Department, P.O. Box 620189, Littleton, CO 80162-9950.

"COMING THROUGH LOUD AND CLEAR ..."

FORMER WACOM CUSTOMERS:

Telewave can support Wacom commercial and amateur products. Many Telewave products share a common design heritage with Wacom, and most of our cavity and isolator products are drop-in replacements for Wacom. We can repair, rebuild, and expand most existing Wacom items or systems without a complete change-out.

- *Antennas*
- *Combiners*
- *Wattmeters*
- *Duplexers*
- *Filters*
- *System Design*

Telewave, Inc. delivers high performance ... everywhere, everytime.

We bring 33 years of product engineering and system design expertise to the table for every customer, large or small.

With a full line of standard products, and the ability to quickly create custom designs for special projects, Telewave provides unmatched support for Public Safety, Government, and Business radio systems.

Call us today at 1-800-331-3396 or +1 408-929-4400 and discuss your requirements with our expert sales engineers, or visit us at **www.telewave.com**

TELEWAVE, INC.®

Wireless Communications Manufacturers Since 1972

Telewave, Inc
660 Giguere Court
San Jose, CA 95133

This issue, *AGL* focuses on **site services**, particularly *monitoring, maintenance* and *construction*. Site construction safety is an ever-increasing concern as tower buildouts proliferate, so we present *(page 32)* the experienced views of **Winton W. Wilcox Jr.**, founder and president of ComTrain, Monroe, WI. Winton brings a detailed knowledge of tower climbing and teaching credentials together for the communications industry. He is an accredited junior-college instructor in both California and Wisconsin. A graduate of the Carolina School of Broadcasting and the University of Nevada–Reno, Winton holds a BS in managerial science with minors in math, history and philosophy. Before founding ComTrain, he served as division manager of Cable Data, vice president for Parallex and president of Broadcast Communication Systems. Winton is the author of *Tower Climbing Safety & Rescue* and numerous magazine articles featured in *Mobile Radio Technology, Electrical Contracting & Engineering News* and *Fire & Rescue.* He has also served as an expert witness for OSHA and has testified in numerous accident litigations.

Continuing with tower-erection safety, our contributors to "Law of Physics" *(page 29)*, **David G. Sarvadi** and **Jeremy W. Brewer,** of the Washington-based law firm Keller and Heckman, address the ramifications of North Carolina labor regulations for our industry. **David** *(far left)* works with clients in the areas of occupational health and safety, and employment law. He is a member of the District of Columbia and Virginia Bars and holds a BS from Pennsylvania State University, an MS from the University of Pittsburgh Graduate School of Public Health and a JD from George Mason University. **Jeremy** *(near left)* also practices employment law and occupational safety and health law. He advises clients on workplace safety matters, including representing clients facing federal and state OSHA citations. Jeremy is a member of the Virginia State Bar, the District of Columbia Bar and the American Bar Association. He holds a BA from Denison University and a JD from American University's Washington College of Law.

Observations on how the FCC is handling implementation of the National Programmatic Agreement affecting siting on tribal lands come from **Connie Durcsak** of PCIA *(page 12; PCIA will host a seminar on the subject in March, see page 13)*. Connie is the wireless infrastructure association's senior director of government and industry affairs. She directs the association's public-policy programs at the national, state and local levels. Connie also oversees PCIA's frequency coordination services. Before joining PCIA, Connie served as a principal consultant with PricewaterhouseCoopers. She holds a BA and a BEd from Acadia University and an MA in business from Marymount University.

The name is **Strickland—*Richard* Strickland.** We're having some good-natured fun with our "field agent" cover story this issue *(page 20)* to draw attention to one of Richard's pet peeves: RF field-level measurements have a significant amount of uncertainty, even when made by a skilled surveyor with the best instruments. Regulating sites on the basis of faulty survey techniques is not good for the industry, and it undermines confidence in the regulators. Richard's Long Island-based company, RF Safety Solutions, advises companies and government agencies on potential RF safety hazards and safe RF environments. His previous appearance in *AGL* was to discuss RF safety signage *(October/November 2005)*, and in the near future he'll tackle questions concerning personal protection equipment for working in RF fields.

Former editorial collaborators and industry experts round out this issue. Some may be new to you. "Klondike State"-based **Donald Koehler** discusses improving network operating center and monitoring operations *(page 38)*. Don has over 30 years' systems maintenance experience in communications equipment for RF-, satellite- and wireline-based environments. He also has supported field operations in overseas locations, such as Korea and the Komi Republic. Don served as a network operations manager for a major Alaskan telecommunications provider and is now involved in the computer-support industry. For borrowing advice, check out **Jarred Saba's** new "Capital Ideas" column *(page 18)*. For a case file on carrier collocation with public-safety agencies, see Massachussetts **Detective John P. Hebb's** siting story *(page 42)*. agl

ABOVE GROUND LEVEL

agl

TIME to SUBSCRIBE... FOR *FREE!*

Become a qualified subscriber to the **only magazine** devoted exclusively to site infrastructure and management: *AGL (Above Ground Level).*

Fax the subscription form below to **(303-972-1653)**, or subscribe online at www.agl-mag.com/subscribe.htlml, to receive an entire year of *AGL* magazine **free of charge!**

Complete all items, sign and fax this form today, or go online to*www.agl-mag.com/subscribe.html* for your FREE subscription to *AGL.*

1. **YES** please send me a free annual subscription to ***AGL***.

Signature (required for subscription) ________ Date ________

2. Please check the box next to your company's or agency's **primary** activity (check only **ONE**):

COMMUNICATIONS SITE SERVICES

01 ❑ Tower/Site Owner/Management
02 ❑ Site Construction Services
03 ❑ Systems Integration
04 ❑ Maintenance
05 ❑ Engineering/Consultation
06 ❑ Legal Services
07 ❑ Site Acquisition
08 ❑ Tower Crew
09 ❑ Other (describe) ________

SERVICE PROVIDER

10 ❑ Cellular/PCS System Operator
11 ❑ SMR/ESMR System Operator
12 ❑ TV/Radio Broadcaster
13 ❑ Wireless ISP
14 ❑ Paging Operator
15 ❑ Community Repeater
16 ❑ Other (describe) ________

BUSINESS/INDUSTRIAL USER

17 ❑ Utilities 18 ❑ Transportation/Railroads 19 ❑ Other ________

GOVERNMENT — Non-public safety

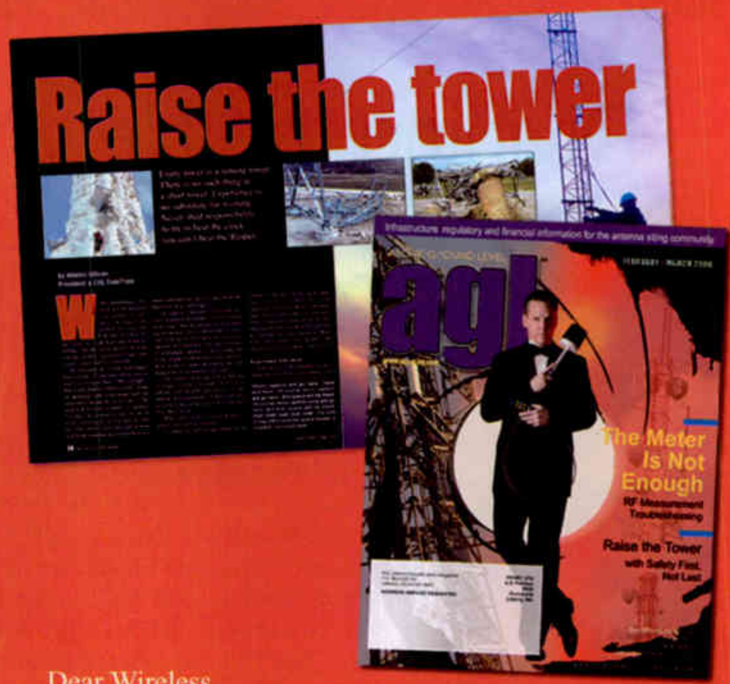
20 ❑ Local 21 ❑ State 22 ❑ Federal/Military 23 ❑ Health/Emergency

PUBLIC SAFETY — Police, Fire and Emergency Medical

24 ❑ Local 25 ❑ State 26 ❑ Federal/Military 27 ❑ Health/Emergency

OTHER PRIMARY BUSINESS (describe): 98 ❑ ________
28 ❑ Manufacturer

Please provide all information requested above to qualify for your FREE subscription!
The publisher reserves the right to serve only those who meet the publication qualifications.



Dear Wireless
Infrastructure Professional,

Wireless communications site specialists need in-depth information about technical, regulatory and financial issues affecting towers, rooftop sites and in-building systems. *AGL (Above Ground Level)*, produced in cooperation with PCIA—The Wireless Infrastructure Association, is the only magazine devoted *exclusively* to this industry.

Complete and fax us this qualification form to receive this valuable resource *free of charge*, or subscribe online at *www.agl-mag.com/subscribe.html.*

Thank you,

Richard P. Biby, P.E.
Publisher

3. My occupation/title is (check only **ONE**):

01 ❑ Corporate Management (Owner, President, CEO, VP, Partner, General Manager); Government Agency Head; Attorney
02 ❑ Operations/Administrative Management
03 ❑ Technical and Engineering
04 ❑ Finance
05 ❑ Sales/Marketing Management
98 ❑ Other (describe): ________

If the name or address above is incorrect or needs updating, please **PRINT** the complete correct information below:

Name ________ Title ________
Company ________
Address ________
City ________ State/Prov. ________ Country ________ Zip/Postal Code ________
Telephone ________ Fax ________
E-mail address for future renewal notices (Confidential; *AGL* does not allow third-party access to your e-mail information.) ________

To send by mail: **P.O. Box 620189, Littleton, CO 80162**, or call: **303-979-0621**

F06

Divining the New Year

I'm one of those people who spend time early in the year trying to figure out *what* is going to happen, what *needs* to happen and *when* is it going to happen. I'm one of those "Set goals for the year and stick to them" kind of people.

The tower industry needs to do that, too. In the wake of two damaging hurricanes, floods and other disasters, I foresee mandated site-hardening standards. You can only do so much to protect against Mother Nature, and nature *will* sometimes win, regardless of what you do. But public perception is that wireless infrastructure companies have not done enough to maintain communications in times of need. Our challenge is to respond with timely and effective voluntary action before congressional representatives create their own idea of "appropriate" mandates—oops, I mean, "improvements."

Post-disaster analyses point out simple things that seem obvious but are not taken care of in the disaster-planning process. For example: the inability to get fuel from storage yards and to towers, hospitals and other sites that have secure infrastructure but run out of fuel after three or four days. This industry could come together and create a national standard or agreement on what sites and network-backhaul elements should be kept operational. But only a fully integrated plan, completely vetted with local, state and national response-planning agencies, can be effective.

Here's another example that drives me crazy: In the aftermath of New Orleans, we've heard about the police not being able to use their portable radios, not because of base station problems, but because there was no ac power to run the NiCd battery chargers. Can we not have an industry agreement to allow public safety access to our sites to use our ac power? A trickle charger is not going to diminish the power available to the transmitter, the lights or the HVAC system.

Also, can we not develop a program to have a single supplier deliver fuel to *all* the carriers' generators at a site, not just one? Competitive advantages are nice, but when lives are on the line, we should work together. Concern about preparedness slacks off, the further you get away from urgency, and details fade after events and time pass. Few want to invest time and energy in expectation of *possible* future events. We only invest after we've been embarrassed by past events.

Getting technical

A friend criticized the Vanu Bose interview last issue, saying it asserted that software-defined radio (SDR) would solve the public-safety interoperability issue. My friend pointed out, correctly, that much needs to happen for interoperability to be successful, and that SDR will be an important part, but not the complete solution.

We agree. But although we touch on some interesting communications topics, we are a support structures (towers and rooftops) magazine. So, we have to let the depths of some wireless topics remain unplumbed. We never want to be incorrect; oversimplification is just necessary, sometimes.

We *are* exploring the idea of starting a magazine devoted to technical systems that use support structures. I'm more of a bits and bytes (or MHz and GHz) person, so this has great appeal. In such a publication, we'll have the space for a full discussion of the details of RF and IT technologies and how they interrelate. If you agree that the knowledge base needs thickening, tell us what topics you wish were better covered in those areas.

Until next time, send us your thoughts, questions and critiques. agl

by Rich Biby, Publisher
rbiby@agl-mag.com

ABOVE GROUND LEVEL agl™

www.agl-mag.com

Infrastructure, regulatory and financial information for the antenna siting community

PUBLISHER/CEO
Richard P. Biby, P.E.
rbiby@agl-mag.com

EXEC. EDITOR/ASSOC. PUBLISHER
Don Bishop
dbishop@agl-mag.com

MANAGING EDITOR
David A. Keckler
dkeckler@agl-mag.com

ART DIRECTOR
Scott Dolash
sdolash@agl-mag.com

ADVERTISING MANAGERS
Mercy Contreras
mcontreras@agl-mag.com
Karen Clark
kclark@agl-mag.com

MARKETING MANAGER
Diane Weidenbenner
dweiden@agl-mag.com

CIRCULATION MANAGER
Karen Clark
kclark@agl-mag.com

CORPORATE OFFICE:
Biby Publishing L.L.C.
P.O. Box 284
Waterford, VA 20197
540-882-4290

PRESS RELEASES AND ADVERTISING MATERIALS MAILING ADDRESS:
Biby Publishing L.L.C.
P.O. Box 1578
Liberty, MO 64069-1578

SUBSCRIPTION INFORMATION: *AGL (Above Ground Level)* magazine is mailed free to qualified persons in the United States working in the antenna siting industry and related services.
To subscribe online, go to:
http://www.agl-mag.com/subscribe.html
To subscribe by mail:
ATTN: Circulation Department
AGL magazine
P.O. Box 620189
Littleton, CO 80162-9950
A subscription form is provided on page 7 this magazine.

Stuck in the Eye of the Beholder

Stick it in your eye—well, words to that effect—is what a federal appeals court told the city of La Cañada Flintridge, CA, in a ruling filed on Jan. 17, 2006. Here's what the 9th U.S. Circuit Court of Appeals *actually* said:

"The Telecom Act requires permit denials be supported by substantial evidence. 47 U.S.C. § 332 (c) (7) (B) (iii) (2005). Because the City overstepped its regulatory authority under state law, its wireless ordinance is invalid, and no evidence supports the City's permit denial. The District Court's conclusion that substantial evidence supported the City's permit denials must be reversed."

The city denied Sprint PCS Assets permission to construct the cellular towers because—they would look bad. You can tell from our covers and centerspread photos that we think towers look pretty good. Amazingly, not everyone thinks so.

What happened in La Cañada Flintridge? Sprint asked for permits to build five towers after the city enacted an ordinance establishing criteria for applicants to satisfy. The city granted two of the permits, Sprint withdrew its request for a third and the city denied the remaining two. Sprint sued for the two remaining permits. A U.S. District Court ruled for the city, which was reversed by the Court of Appeals last month.

Here are the ordinance's criteria:

"(1) The proposed above-ground structure does not obstruct access for pedestrians, nor block view [sic] of vehicles, pedestrians or bicyclists;

"(2) The proposed above-ground structure is compatible with existing above-ground structures along the public right-of-way, and does not result in an over-concentration of above-ground structures along the public right-of-way;

"(3) The proposed above-ground structure preserves the existing character of the surrounding neighborhood, and minimizes public views of the above-ground structure; and

"(4) The proposed above-ground structure does not result in a negative aesthetic impact on the public right-of-way or the surrounding neighborhood."

The Court of Appeals found that reasons 2, 3 and 4 primarily involve *aesthetics.* It found that the city made its decision *based* on aesthetics. The court ruled that it is *not consistent with California and federal law* for a city to deny a permit to construct and to install a wireless antenna based on aesthetics.

Wow. Tell me again, *what* happened?

The Court of Appeals analyzed and dissected the state law that gives telephone companies broad authority to construct telephone lines and other fixtures "in such manner and at such points as not to incommode the public use of the road or highway or interrupt the navigation of the waters." The court decided that "[B]y the plain text of the statute, the only substantive restriction on telephone companies is that they may not 'incommode the public use' of roads."

The Court of Appeals ruled that the state has an interest in ensuring that telephone companies can build facilities to deliver service, that the state law didn't say anything about restricting the facilities based on aesthetics and that the state law supercedes local ordinances.

The California legislature could enact new law to allow California cities to consider aesthetics when reviewing applications for tower construction permits. Also, La Cañada Flintridge could appeal the ruling to the U.S. Supreme Court, which reversed one of the 9th Circuit's decisions last year in the antenna case, *City of Rancho Palos Verdes v. Abrams.*

However, absent new law or an appeal, cities in California no longer can consider aesthetics when deciding whether to grant an application for a permit for a cellular telephone tower. agl

by Don Bishop, Exec. Editor
dbishop@agl-mag.com

Picture of the Month:

Tower riggers recently arrived at a tower site near Prudhoe Bay in northern Alaska to discover a female bear perched atop the ice bridge over the tower's transmission lines. The bear's cubs were not available for comment. Send us your amusing photo for the next 'Picture of the Month.'

Declaratory Ruling Breaks Tribal Consultation Logjam

Hundreds of new towers can now be built thanks to response-time limits, and the courts may clarify federal jurisdiction over antenna facilities.

by Connie Durcsak

On Oct. 5, 2005, an FCC *Declaratory Ruling* caused the wireless industry to heave a sigh of relief. The ruling, "Clarification of the Procedures for Participation of Federally Recognized Indian Tribes and Native Hawaiian Organizations Under the Nationwide Programmatic Agreement," meant that after more than six months "in limbo," new tower builds could finally proceed.

Under Section 106 of the *National Historic Preservation Act of 1966* (NHPA), federal agencies must account for the effects of undertakings, such as permitted projects, on historic properties. The FCC interprets this mandate as including antenna facilities.

Given the proliferation of wireless infrastructure, the FCC and the historic preservation community determined that an agreement regulating new tower construction was needed. That *Nationwide Programmatic Agreement for Review of Effects on Historic Properties for Certain Undertakings Approved by the Federal Communications Commission* ("NPA" for short), was unveiled during PCIA's annual conference in October 2004.

Not all stakeholders were happy with the agreement. Two FCC commissioners at the time, including Kevin Martin, now chairman, partially dissented from approving the agreement, asserting that the Commission was exceeding its authority by regulating antenna facilities because these projects do not require FCC permits and are *not*, therefore, "federal undertakings." The carrier community challenged the "federal undertaking" premise in federal court.

The implementation of the NPA did illuminate the magnitude of a problem that had been plaguing Section 106 reviews for years: tribal nonresponse to industry requests for consultation. Pre-NPA, this often meant that industry would proceed without input from tribes.*

The NPA, however, requires industry to refer nonresponses to the FCC, which will attempt to consult intergovernmentally with the tribes. Although the NPA allows the FCC to authorize applicants to proceed in the absence of tribal authority response to these consultation requests, the FCC elected instead to pursue consultation beyond the established deadline. Accordingly, no applicant could proceed until the FCC had engaged 100 percent of the tribes expressing interest in a particular location.

> On March 2, 2006, PCIA will host a one-day seminar on strategies for complying with the NPA at the Bellagio Hotel, Las Vegas. This seminar will offer information for carriers, tower companies, site owners and operators, turnkey providers, site acquisition professionals, RF engineers, attorneys and others involved in wireless antenna siting and deployment. For more details, visit *www.pcia.com*.

The stalemate was disastrous for the wireless industry. By the time of PCIA's next annual meeting in 2005, more than 775 applications had been referred to the Commission, with nearly half still pending after their NPA deadlines had passed. Subsequently, PCIA and other industry groups communicated almost daily with the Commission to urge a swift and definitive resolution.

One year after releasing the NPA, the FCC adopted the tribal consultation *Declaratory Ruling*, giving tribes a 20-day window to respond to Commission notification. Otherwise, the ruling stipulates, "The applicant's pre-construction obligations under the Nationwide Programmatic Agreement are discharged with respect to that Indian tribe." Additionally, all applications filed before Sept. 10, 2005, were authorized to proceed, as the Commission deemed it had met its intergovernmental consultation obligations.

The *Declaratory Ruling* put an end to the crisis, but not the story. If the courts decide antenna facilities are *not* federal undertakings, it follows that many federal environmental and historic preservation laws currently imposed on wireless infrastructure will no longer apply. Related federal rules and regulations—such as Section 106 reviews—would go away. As this matter makes its way through the courts, the industry once again holds its breath. agl

*This practice has legal precedent. In the case of *Narragansett Indian Tribe v. Warwick Sewer Authority*, 334F.3d 161, 168 (1st Cir. 2003), the U.S. Court of Appeals concluded that a tribe's right to consultation under Section 106 terminated when a tribe has failed to respond to repeated requests for review.

Durcsak is senior director of Government and Industry Affairs for PCIA.

If You Build It, Will They Come?

by R. Clayton Funk

Continuing from last issue, "Johnny Multiple," fresh off the success of building, developing and selling his first tower company, "TCF Tower Company," has decided to see if he can make his magic happen again by establishing "20× TCF Tower Company."

As one of the terms of the TCF sale, Johnny is restricted from operating within the "State of Restrictive Zoning" by a noncompete agreement. So, Johnny decides to pursue build-to-suit agreements and acquisitions in the adjacent "State of No Zoning."

The State of No Zoning is truly unique, in our example, in that there are no restrictions on development of any kind: Nuclear power plants are next to fireworks factories, landfills are proximate to public parks, weight-loss centers share buildings with all-you-can-eat buffets and 24-hour nightclubs are nestled up against churches.

While Johnny understands the risks of building and owning towers in a state where there are absolutely no restrictions on the development of towers, the residents of the State of No Zoning still want their cellphones to work, and the increased demand for wireless services has carriers deploying sites throughout the state.

Johnny's buddy at the state's largest carrier, "Perfect Coverage Wireless," is an RF-design expert named "Ernie Engineer." Ernie tells Johnny that Perfect Coverage plans to develop 100 sites in the state over the next 12 months and suggests that Johnny put a bid in for the business.

Although Johnny made a lot of money in his sale of TCF Tower Company, he still doesn't have enough capital to develop 100 towers in 12 months, so he needs to find another equity partner to help him realize his goal of starting, and then ultimately selling, 20× TCF Tower Company.

Fortunately for Johnny, his earlier success caught the attention of several private-equity investors who want to invest in tower assets. Johnny begins calling and visiting many of these firms but, to his dismay, many of them decline to invest in a new venture where there will be no barriers to entry for competitors. After all, when building towers in the State of No Zoning, you lose one of your key value drivers for a tower site: a barrier to entry through restrictive zoning environments.

Even when he finds an investor, Johnny cannot hang on to it. One of the investors that had initially committed to backing him, "Hard-nosed Capital," found another entrepreneur to partner with to build towers.

One company, finally, does sees an opportunity in backing Johnny. It is willing to put some money to work behind a proven operator, despite the risks.

"Flush With Cash Capital" offers to commit $10 million to Johnny's new tower company provided that Johnny will also invest some of his own money. But in return, FWCC offers Johnny 20% of the company.

Johnny, who only owned 10% of his previous company, is ecstatic about his ownership position and signs the operating agreement with Flush With Cash Capital without hesitation. After hiring a management team and some operations folks, 20× TCF Tower Company is ready to take on the world.

Armed with his capital partner and some suggestions offered by Ernie Engineer, Johnny and 20× TCF submit a proposal to Perfect Wireless to build 100 towers over the next 12 months.

To secure the deal, 20× TCF does not require Perfect Coverage Wireless to sign any leases until the carrier is ready to deploy their equipment on each tower. Perfect Coverage Wireless awards the build-to-suit agreement to 20× TCF with little hesitation.

With a large amount of fanfare and a flurry of press releases, 20× TCF Tower Company announces the deal and immediately begins to build towers throughout the State of No Zoning. After three months and no delays due to bad weather, construction crew issues or zoning battles, 50 towers are erected on leased property and sit—empty but ready—where Perfect Coverage Wireless can deploy the 100 sites they planned for the year.

And *then* the call comes from Ernie Engineer to Johnny's cellphone:

"Johnny—bad news. Due to low ARPU and decreasing MOUs, we are shutting down the build plan ASAP. I guess you are just SOL."

It is a dark day for Johnny Multiple and his dreams of 20× TCF Tower Company striking it rich. He and his investors have spent $5 million to build the towers. He is paying rent on 50 ground leases. He has a large employee base to support, and yet there is no revenue from Perfect Coverage Wireless or any other carriers.

We'll pause the train wreck here for this issue, as you might find yourself cringing at Johnny's predicament.

What lies next for Johnny? Flush With Cash Capital gets impatient as money continues to hemorrhage in the form of ground leases and salaries, and Johnny must confront the fact that his ambition of selling his company for 20× tower cash flow is rapidly disappearing under the weight of 50 empty towers.

Can Johnny work some magic to save his dreams? agl

Funk is vice president of Media Venture Partners, San Francisco.

Cybercoverage for Your Business

by David Saul

If an intruder wearing a ski mask and black Spandex breaks into your data or operating center to beat three of your servers with a baseball bat and spray-paint them blue—don't worry. Your property coverage will kick in and cover the loss.

However, if a 20-year-old, dressed in a floral shirt and flip-flops manipulates your firewall, gains access to those servers remotely and deletes or alters the data residing on them, you *are* in trouble. Traditional insurance products do not cover such malicious activity.

One could argue that data *is* property. Is lost electronic data "property damage," within the meaning of a standard insurance policy? What's the extent of protection for copyrighted material when it's disseminated through a website? Can one user sue another for passing along a computer virus? Does an E&O policy cover Internet-related defense costs? Specific language in the general liability policies excludes "cybercoverage."

Cyberliability coverage has been developed to "fill in the gaps" not covered because of errors or ommissions in traditional general and property policies. Experts in the legal and insurance industry understand that these other types of coverage fall short.

Indeed, how often do we have to hear reports of unpatched vulnerabilities, outdated firewall configurations and *still more* security holes, that have allowed hackers, frauds, viruses and worms to cause costly damage, before we wake up to the fact that technology in isolation is not enough?

Insurance client companies may know a little about the availability of cyberliability insurance, but many are still far from signing on the dotted line to buy such policies. Still, as more insurers exclude Internet threats from property or other traditional corporate policies (at the same time that cybercriminals continue to make their presence known), cybersecurity insurance providers grow optimistic that an upswing in purchases is on the horizon.

But be aware that, while this type of coverage has been around for seven or eight years, it is still relatively new and immature. Because security liability insurance is so new, we suggest that before you buy a policy, have someone—preferably an insurance agent or technical attorney—review it with a fine-tooth comb. Some questions to ask:

- Does the policy cover all areas of risk, indirect and direct damages incurred from carelessness and attacks, and viruses from within and without?
- Does the insurer require a thorough security assessment?
- How often does the insurer perform cybersecurity "inspections"?
- Does the insurance policy pass the review of an IT and/or insurance attorney?

Specific features of a cyberliability policy are:

- a definition of "cyberspace activities" specially crafted for each account.
- coverage for distribution of content and for errors and omissions in services (both on- and off-line).
- protection of the innocent-insured from intentional, unauthorized access or the wrongful conduct of "rogue" employees.
- allegation of intentional wrongful conducts is covered until final adjudication. **agl**

David Saul is vice president of Atlantic Risk Management Corp., Columbia, MD, and an accredited advisor in insurance. His email is: *dsaul@atlanticrisk.com*.

The Basics Behind Raising Capital for Tower Company Expansion

A proper understanding of terms associated with lending will help you to evaluate a loan's structure and whether it will work for you.

by Jarred Saba

You are positive that "the corner of Elm and 1st" would be a perfect location for a tower. The only problem is that you do *not* have the $300,000 in capital needed to build.

You need to evaluate your options.

You could wait for months—or years—to accumulate the required capital from cash flow. However, there are downsides to this approach. For example, another tower might be built in the area while you are waiting, and there will be competition for tenants. Another downside is that zoning or other local ordinances might change unfavorably.

Another option is to sell another tower to generate the needed capital sooner. The disadvantage of this approach is that you are trading away the upside of any future collocation revenue.

The prudent approach is to keep your existing tower assets and to *borrow* the capital to achieve the same objective. In this and future columns, I will show you how to raise the capital you need to expand your business.

Before we get into the intricacies of the lending world, let's go over the basic terminology of lending. A proper understanding of these terms will help you to evaluate a loan's structure and whether it will work for you.

Term sheet — The term sheet is a document issued by the lender which lays out most of the details of the loan. The term sheet is *not* a binding legal document. An option, commitment letter, or letter of intent may be used to bind one or more parties to the terms of the transaction.

Loan term — The maximum length of time that an outstanding balance may remain under the loan.

Interest-only period — Portion of the term when the payments are *all* interest, and there is no reduction of the principal (that is, no amortization). For example, the borrower has a 20-year loan with a three-year, interest-only period and a 17-year amortization. This means that for the initial three years, the payments would include only interest and the 17-year piece would include interest and principal. This is advantageous to tower owners because the interest-only period reduces the monthly debt service required during the initial three years, allowing time to collocate tenants on the tower.

Amortization — A reduction of debt by scheduled, regular payments of principal and interest sufficient to reduce the loan amount during the term. Some borrowers think that "amortization" and "term" are one and the same; they are not. Think of a 10-year loan with a 15-year amortization. This means that payments would be made as though the loan would last 15 years, but at the end of the 10-year term, a large "balloon" payment would be due.

Negative amortization — While an interest-only period may be beneficial, negative amortization may be dangerous. If the monthly payment applies to interest only, but is insufficient to cover the actual calculated interest amount, the additional accrued and unpaid interest is added to the principal balance. If the borrower is unable to promptly place tenants on the tower, then the outstanding principal balance can quickly grow to exceed the value of the tower.

Balloon — The loan balance that is due at the end of the loan term. Using the example from "amortization" above, the balloon payment would be the excess money due at the end of the 10-year term.

Bullet — A one-time payment of principal and interest due at the end of the loan term. A bullet is similar to a balloon, except that a bullet loan has no current cash flow to support repayment. To satisfy the bullet, a borrower may need to refinance the loan or sell the collateral.

Personal guarantees — Personal guarantees allow a lender to hold an individual, or individuals, personally responsible for a loan. The lender may accept anything from real property, such as a private residence, to personal property as collateral for making loan. Or the lender may rely on the personal guarantee based on the guarantor's other income sources. Personal guarantees are among the least-favorable terms of a loan and may preclude the guarantor from obtaining other personal financing.

Personal guarantees are among the least-favorable terms of a loan and may preclude the guarantor from obtaining other personal financing.

Corporate guarantee — Corporate guarantee allows a lender to only hold a corporation (rather than an individual) responsible for a loan. The lender can attempt to recover the loan balance from the general corporate assets.

Covenants — These are requirements that a lender puts on a borrower when a loan is committed. For example, a lender may require the borrower to maintain a minimum liquidity level or a minimum net worth. If the minimums are not maintained, then the loan may be in default—even though the loan payments have been made on time.

Advance rate — The advance rate is the amount of money, stated as a percentage of collateral value or as a multiple of recurring cash flow from the collateral, that a lender will advance to a borrower. This is usually a direct reflection of the amount of *net tower cash flow (NTCF; see below)* the tower produces. Lenders usually advance between five and six times the annual NTCF. A higher advance rate allows the borrower to put more capital to work on the same asset.

Net tower cash flow — This is an equation that lenders use to determine the amount of money that a tower generates annually. NTCF is usually calculated as tenant rent, minus ground rent, operating expenses and taxes:

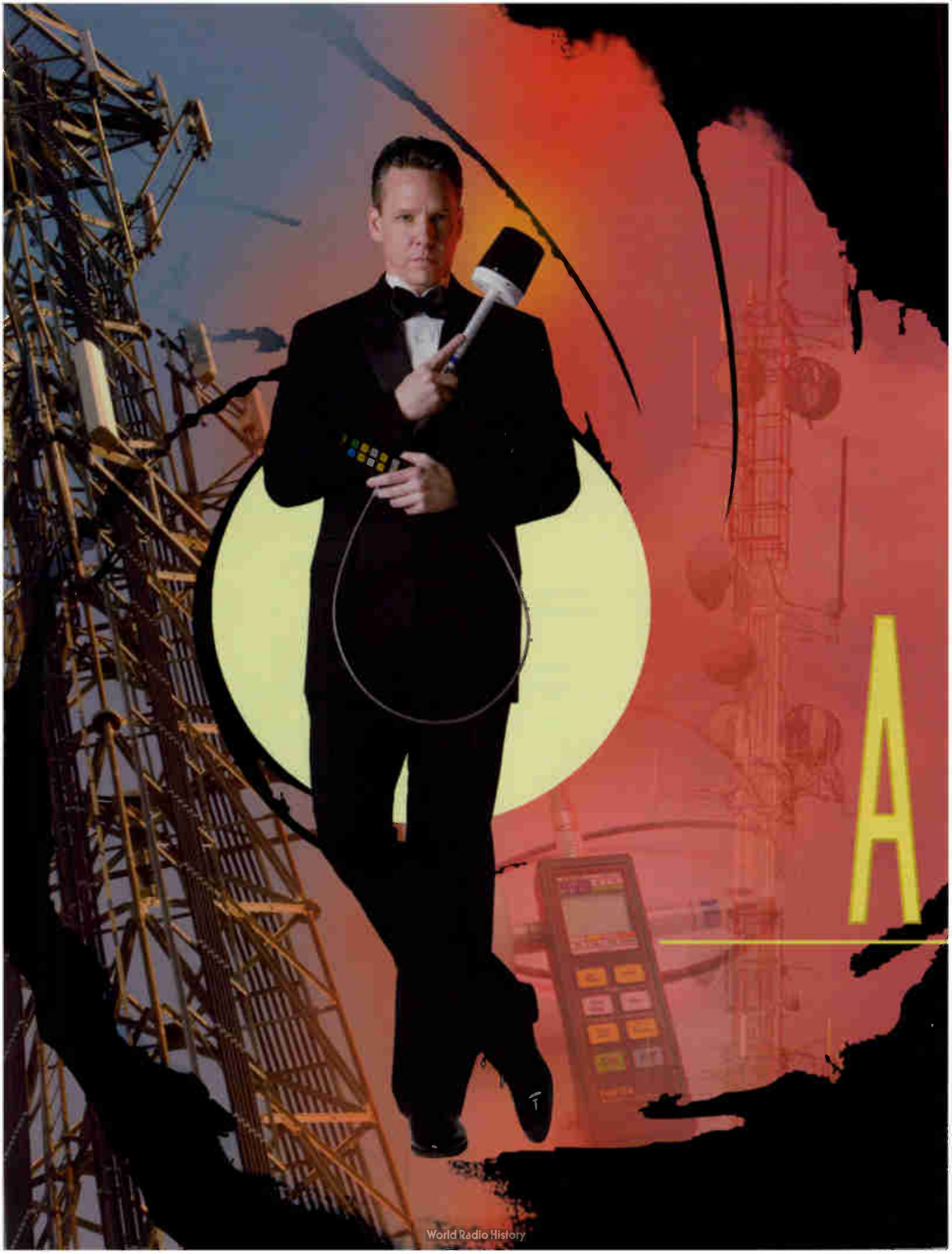
	Monthly income	Monthly expenses
Tenant income #1	$1,500	
Tenant income #2	$1,500	
Ground rent		$500
Operating expenses & taxes		$500
Total Income:	$3,000	
Total Expenses:		$1,000

NET TOWER CASH FLOW = $2,000
ANNUAL NTCF (NTCF × 12) = $24,000

It is important to clearly understand these terms. The most-established borrowers, having the most attractive collateral, are able to obtain loans with higher advance rates, minimal covenants and no personal guarantees. A borrower with a less-established performance history will generally need to build a credit record by successfully building and operating towers and repaying debt. If a borrower can structure a loan with these features, then finding the right term, amortization and interest-only periods will be easy.

Next time, we will dive into the more advanced aspects of finding a loan to understand and address why traditional lenders are not accustomed to lending in the tower sector.

Jarred Saba is director of the Tower Lending Group and the Corporate Finance Group for Wireless Capital Partners, Santa Monica, CA. If you have specific questions about debt and capital that you'd like to have him address in this column, you can email him at *jsaba@wirelesscapital.com*.


A

RF field surveying missions yield misleading results if proper equipment calibration and procedures are not followed. Even **government agents** with a 'license to NAL' make mistakes. Spatially averaged measurements provide a more reliable **reconnaissance** of the target.

View To A 'NAL'

by Richard Strickland

Art and design by Scott Dolash; photography by Thomas Gibson;
RF test equipment courtesy of Narda Safety Test Solutions.

RF field measurements are taken to reveal any potential safety threats and whether a site, or an area, complies with applicable regulations. People often ask me, "Is it easy to measure RF fields?" The difficulty, or complexity, of the task depends on *what* is being measured, the *level* of precision required, the survey *equipment* being used, and the knowledge and skills of the *person* making the measurements.

I have taught technicians to check for leaks in waveguide transmission lines and taught industrial hygienists and maintenance workers—with no electronics background—to check for leaks around semiconductor processing equipment. In both cases, the task is relatively simple: find the leak and get it fixed. No great precision is needed. On the other hand, I have looked at results from surveys at sites where I have worked and known immediately that the surveyor misinterpreted what he saw.

Equipment briefing from 'Q Branch'

My friend Edward E. Aslan (principal engineer at Narda Microwave and an IEEE Fellow) once wrote a scholarly paper on measurement artifacts. Because Aslan holds more than 90 percent of the worldwide patents for the design of RF survey instruments, he knows what he is talking about. I took much of what I learned from Aslan and taught a course for professional engineers, through the National Association of Broadcasters, that explained some of the odd survey results that many of them had seen and could not explain. These measurement artifacts are a combination of equipment-design issues and interactions between the RF field, the instrument and the surveyor.

RF field-level measurements always have uncertainty, even when made by a skilled surveyor using the best available instrument. Measurement uncertainty has three major components:

- measurement uncertainty due to the instrumentation.
- perturbation of the field by the surveyor.
- time and spatial variations in the field.

Some common measurement problems encountered even with the best equipment are false readings caused by 60 Hz pickup, zero drift and static pickup. Measurements below 30 MHz (and especially below 10 MHz), are particularly challenging. They require special techniques to compensate for the interaction of the survey equipment, the surveyor's body and the electrical field. Anyone who has ever made measurements around an AM station knows how difficult it can be to get good results.

Sometimes, these measurement errors don't pose a problem. For example, I often see modest fields reported on the ground close to a tall broadcast tower, when the reality is that the fields are below the measurement threshold of the instrument—the surveyor is simply reading zero drift. On the other hand, I have seen reports that a rooftop environment was not in compliance, yet actual field levels were negligible. The surveyor was getting false readings from 60 Hz pickup or static from something like a nylon windbreaker. Of course, if you are inspecting for the FCC and you make such mistakes, it can cause problems.

Obtaining reliable intelligence

The methods and techniques used to make measurements should vary with the situation. I first check large areas on the ground or roof by moving the probe position in the three spatial dimensions, looking for peak field readings. If none exceeds 25 percent of the FCC's maximum permissible exposure (MPE) limit for general population/uncontrolled exposure, I make a couple of spatially averaged measurements and document them accordingly.

My report might state that the spatially averaged field levels in this area ranged from 15 to 25 percent of the MPE limit. I don't get carried away trying to determine whether the averaged level is 17 percent or 19.5 percent. First, no one really *cares*. Second, to do so implies a level of precision that is impossible to achieve. Each of my reports states my assessment of the field levels but also includes an advisory section that discusses measurement uncertainty of the instrument. (Actually, measurement uncertainly is more often a function of the techniques used and the variable nature of the fields than of the capabilities of the instrument.)

When you do find spatial peaks that exceed the MPE limit, you have to be more careful in evaluating the fields in that particular area. I make a minimum of three spatially averaged measurements. If all three measurements vary no more than 10 percent, and none shows field levels that exceed the limit, I average the three. If I see more than about a 10 percent variation among the three readings, I keep making measurements until I am satisfied that I have obtained consistent, repeatable readings.

Our Company spray paints towers.

This provides streak free,
uniform coatings with
less paint damage
to the surrounding areas.

We specialize in
painting tall towers,
congested towers
in difficult locations,
and rooftop towers.

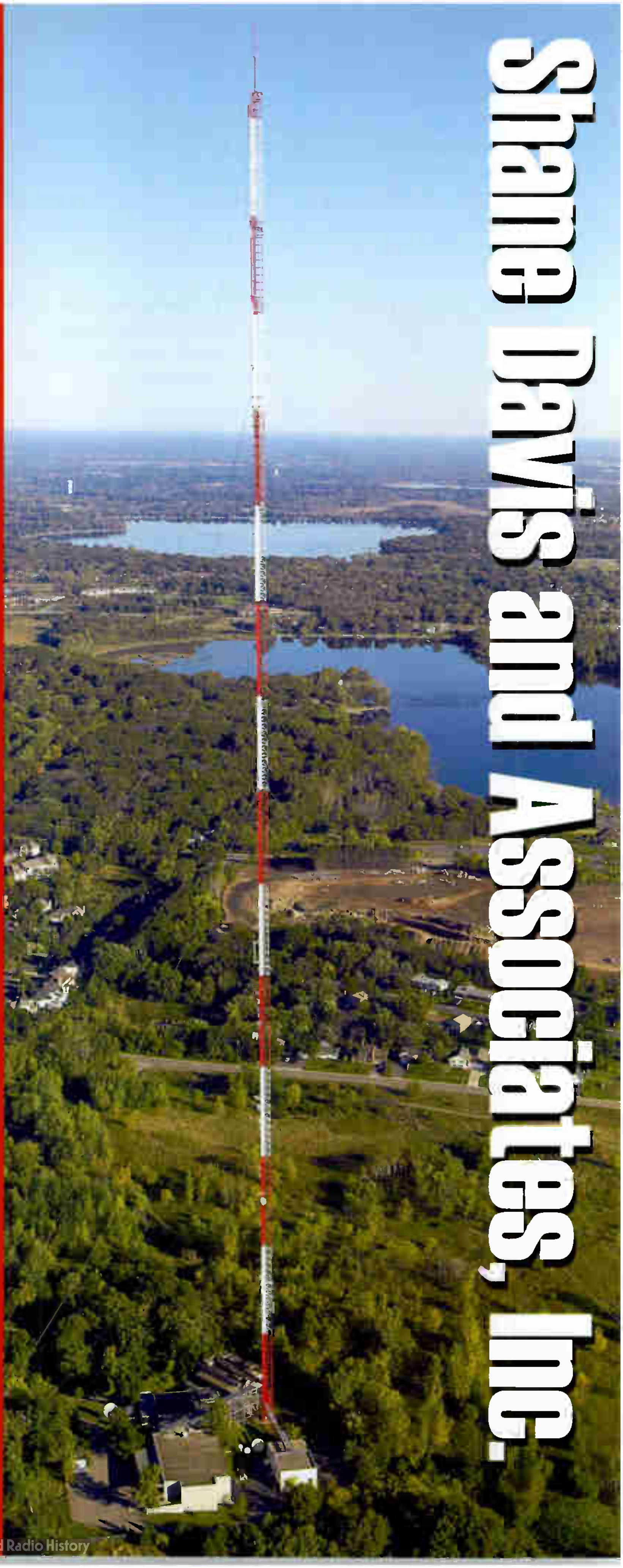
We use the best materials:
Keeler & Long and
Sherwin Williams paints.

We have a written
Safety Program,
ComTrain Certificates,
OHSA Certification and
Hoist Operator Certifications.

Members of the
National Association
of Tower Erectors (NATE),
6 Million in General Liability
Insurance and Elevated Steel
Painters Insurance.
We will also list customers as
Additional Insured at
no additional cost to you.

We are a Professional Tower Painting Company.

Shane Davis
and Associates, Inc.
www.towerpainter.com
866-967-0570 Toll Free
863-968-0570 Fax



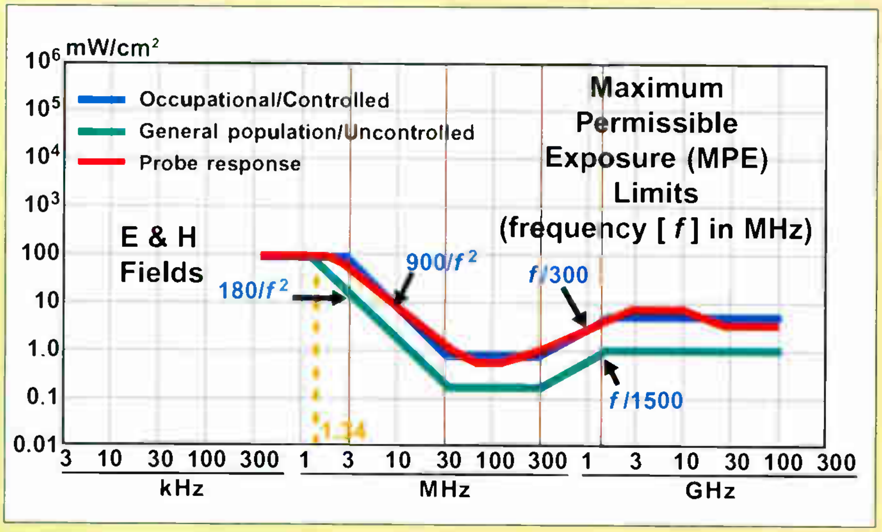
If the readings indicate that the area has levels that exceed the MPE limit by a small amount, and classifying the area in this way would affect operations, I try to further refine the measurement. For example, if I initially got a reading of 110 percent in a small area that nonqualified personnel frequent, I would take the time to see if more precise techniques might yield a number below 100 percent. This normally means not only using spatial averaging as a function of height but also taking into consideration the effect of body position on measurements.

Distinguishing friend from foe

Virtually all RF safety measurements are made with broadband instruments—a probe and a meter. The accuracy of a survey instrument is almost entirely determined by the accuracy of the probe. Most probe specifications are expressed in decibels (dB). A parameter that has a 1.0 dB tolerance means the value could be off by 26 percent. By contrast, even a simple meter should be accurate to within five percent.

Frequency deviation is the most important characteristic that contributes to measurement uncertainty, but it is not the only one to consider. FCC regulations, and all major worldwide standards, have exposure limits that vary as a function of frequency. The growth of wireless services and the deployment of digital television have led to a growing number of sites that have multiple emitters operating at frequencies with different MPE limits. This has led to the use of shaped frequency-response probes as the primary tools used for surveys of wireless and broadcast sites.

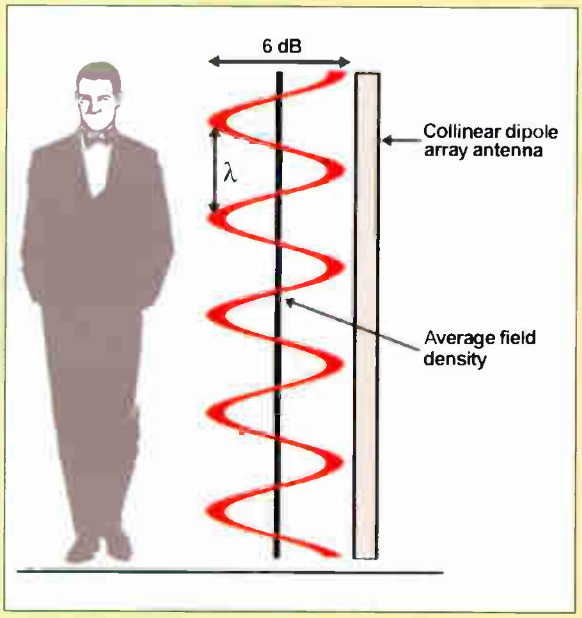
Shaped frequency-response probes are designed so that sensitivity at the point of detection varies over frequency range. The goal is to match a standard, such as the FCC regulations, as closely as possible. Narda Microwave holds the patent on this technology, which is similar to a filter. It is impossible to make the sensitivity match the MPE limits exactly. The greatest errors tend to occur at the transition points where the MPE limit changes from a constant to a slope, or vice versa. In the FCC regulations for occupational/controlled exposure, these transition points occur at 3 MHz, 30 MHz, 300 MHz and 1,500 MHz. *(See graph at left.)*



The red line shows the typical frequency response of a Narda 8700 series shaped frequency-response probe, compared to the 1997 FCC regulations. Note that the greatest deviations from the FCC MPE limits occur at the transition points. The design of the tuning circuits causes the response to 'round' at these points. These probes include calibration frequencies at or near each of the transition points.

Calibrating your sights for action

As previously mentioned, the major component of measurement uncertainty for a probe is normally its frequency deviation. The Narda Safety Test Solutions Model A8742D probe I use is calibrated at 14 frequencies to guarantee that the frequency deviation—error vs. frequency—is a maximum of ±2 dB. Other characteristics, such as ellipse ratio and isotropic response, are less significant than frequency deviation but they cannot be ignored. *A good rule of thumb when making measurements in multisignal environments with this type of equipment is to assume an uncertainty of ±3 dB.*



Standards for human exposure to RF radiation specify MPE levels averaged over the whole body. Collinear dipole antenna arrays commonly used in wireless communications have multiple lobes close to the antenna. Field strength typically varies by 6 dB along the length of an array. Therefore, the measured value depends not only on the distance from the antenna but also on the height above ground level.

The ±3 dB figure for measurement uncertainty is only applicable for the Narda 8700 series shaped frequency-response probes. These probes are tested at multiple frequencies and have a guaranteed maximum deviation of ±2 dB over their entire frequency band. The other brand of shaped frequency-response probes is also supplied by Narda Safety Solutions. The

Type 25 FCC shaped probe is used with the EMR series of meters. This probe *does not* have a guaranteed maximum frequency response error. Most of these probes have been sold with only a single calibration frequency: 100 MHz.

If measurements are made where there is only a single emitter or where all emitter frequencies are close to each other, as in the case of a site with only cellular service, a correction factor can be used to reduce the amount of measurement uncertainty. This normally reduces overall measurement uncertainty from the instrumentation to about ±1 dB. The use of correction factors is less accurate when one attempts to interpolate between two calibration frequencies near the transition regions of the probe.

A miss is as good as a mile

Spatial averaging is an important technique that reduces the amount of measurement uncertainty when assessing an RF environment. This technique is important for both wireless and broadcast systems.

Most wireless systems antennas are collinear dipole arrays. These antennas are made up of a series of radiating elements that are normally spaced one wavelength apart. A common measurement requirement is to determine the strength of the RF fields on a rooftop near one or more of these antennas. Even if there is only a single antenna to consider, and its output power is held constant, it is possible to obtain field-level measurements that vary by as much as 6 dB above exactly the same point on a rooftop. *(See the diagram on page 24.)* This is because there is roughly a 6 dB, or 4:1, ratio between each peak and null of the electric field. Because the radiating elements are spaced one wavelength apart, the vertical distance between peak and null is only half a wavelength. If an "X" is marked on the roof, and two measurements are made directly above that point, a difference of about six inches in height can yield readings that vary by as much as 6 dB at cellular and paging frequencies. At PCS frequencies, the vertical distance between peak and null is about three inches. This variance can occur when both measurements are in line with the antenna and is independent of a partial-body-exposure scenario. In contrast, spatially averaged measurements will be far more consistent.

A difference of about six inches in height can yield readings that vary by as much as 6 dB.

Knowing the lay of the land

The RF field levels from a TV or FM broadcast antenna are normally quite low at ground level and increase as a function of elevation above ground level, with the maximum level occurring at an elevation of one quarter-wavelength above ground level. For FM stations, this means that the peak fields are roughly 2½ feet above the ground. The field intensity then drops off as elevation increases. The ratio of field strength, from peak to null, is typically 8:1 or greater.

Multisignal environments, typical of the many broadcast antenna farms, are far more complicated because of various wavelengths and the interactions that take place between fields near ground level. *Field levels in these environments vary dramatically in all three dimensions and as functions of time.* Even spatially averaged measurements will not be totally repeatable. Field levels also vary due to the interaction of the surveyor's body with the field. *Even with these variables, spatially averaged measurements will be far more accurate and repeatable than making measurements based on looking for spatial peaks.*

Double-O accuracy/'double trouble'

The FCC stepped up enforcement of its RF radiation regulations about four years ago. Unfortunately, the agency has been making measurements with instrumentation that typically overestimates field levels by about 2:1 and has also been using an inaccurate, indefensible deferential approach to determine compliance at antenna farms.

The FCC purchased several sets of survey equipment and trained its inspectors in Denver in the spring of 2003. Shortly thereafter, I surveyed a small broadcast site on a mountaintop outside of Denver. This was a simple site, with one high-power TV station antenna and two low-power station antennas on a single tower. On arrival, I told the chief engineer that I was going to start on the high side of the site outside of the enclosure, as I thought that was where we might find the highest field levels. He then told me that the FCC had been there a few days earlier and that they had found a "hot spot" in exactly that area. I then made several spatially averaged measurements in the area and found an average field level of only 55 to 60 percent of the public MPE limit.

I checked with the FCC to determine *why* they were going to require the high-power station to lower its power (until some RF safety "NOTICE" signs were installed), and found that they had measured field levels of about 120 percent. This bothered me—why should our two sets of readings vary by *a factor of two* at such a simple site? The FCC even confirmed that virtually all the energy was from the high-power station by making the station shut down. I had my probe personally checked by Narda's Ed Aslan, and was assured that my equipment was accurate to within about three percent at that station's frequency.

About four months later, I did a survey at the big antenna farm on Mt. Wilson, outside of Los Angeles. One of the workers showed me the spray-painted spot on the ground that the FCC had recently marked as having the "highest field levels on the mountain." *[This inspection was discussed in "What You Should Know About MPE," in the June/July 2005 issue of AGL—Editor.]* I made a couple of quick checks in this small area and measured only about 80 to 90 percent of the public MPE limit. I didn't do more, as I was there for other reasons.

About a month later, the FCC issued a *Notice of Apparent Liability for Forfeiture (NAL)* to three FM stations and one TV station for jointly exceeding the public limit in this area, an area justifiably deemed public since access was not restricted. The *NAL* stated that the field

Proper Surveillance Techniques

The FCC approves and encourages spatially averaged measurements, but it does not define *how* they should be made. The most common method uses a timing function in the instrument. When the probe is moved vertically at a uniform rate of speed, you get an average over the height of a person. A typical logging rate is 32 data points per second. A typical 10-second spatial average will be based on more than 300 measurements.

The more nonuniform the field levels are, the greater the variance that can be expected. The fields at multiple-emitter broadcast sites can vary dramatically in intensity over a distance of a few inches *in any direction*. It often requires at least five spatially averaged measurements in the same location to have the confidence that a reasonably accurate measurement has been made. It is not just a matter of averaging the spatially averaged measurements. Experience teaches the surveyor to know which measurements should be *ignored*.

Assuming that the surveyor does not move his or her feet, the averages can vary because of a nonuniform rate of speed and/or because the probe is moved over a slightly different area. If field levels are highest at head height, a slight delay in stopping the measurement adds a disproportionate amount of energy from the highest field area to the average. Similarly, if the highest field levels are near the ground, a slight delay in starting to move the probe after pushing the start button can have similar results. Of course, the field levels often change between measurements, causing even more deviation.

If the surveyor moves his or her body and attempts to make spatial averages over the same point on the ground, one often sees large differences in readings due to the influence of the surveyor's body on the measurements. In some cases, the body can block the energy from reaching the area being measured. In other cases, the probe may detect energy that is a combination of the actual fields and of additional energy reflecting off the surveyor's own body.

One highly regarded expert in the field who has made thousands of spatially averaged measurements believes that it is difficult to repeat the same measurement to within five percent, even when the greatest care is taken. This assumes that:

- the surveyor does not move and attempts to measure the exact same spot.
- nothing changes in the fields that are being measured.

Realistically, if a series of spatially averaged measurements are within 10 percent of the mean, the surveyor is being careful.

If a series of spatially averaged measurements made with the surveyor in one position indicates that the field levels are close to the MPE limit, then it is necessary to take additional measurements to average out the effects of the surveyor's body on the measurements. The best way to do this is to perform four or five spatially averaged measurements while standing in one position, and then repeat the procedure in a minimum of three other positions. It is critical to make sure that all measurements are always made with the probe positioned over the same point on the ground. Although this concept may seem obvious, at least one organization has been erroneously teaching people to stand in one position and to simply rotate their body. Of course, this results in a series of measurements that are made over different points in a circle that is about six to eight feet in diameter (depending on the length of the surveyor's arm and the length of the probe).

level in this area of noncompliance measured "160.5 percent" of the public MPE limit. Imagine that: *four-digit* measurement accuracy. It was also about *double* what I had measured. The FCC claimed that one FM station had field levels of about 80 percent of the MPE limit; the other three stations had field levels between 10 and 12 percent. The other 18 stations partially illuminating the spot were deemed to have field levels below 10 percent. The *NAL* claimed that the FCC used 10 percent, rather than the 5 percent specified in its regulations, to allow for measurement uncertainty.

I did some digging and checked into the instrumentation that the inspectors were using. Yes, the FCC had paid to get multiple-frequency calibration performed on their Type 25 probes. But unfortunately, the survey sets did not have the frequency deviation *centered*, as with the equipment that I use. A review of the calibration data clearly shows that all the FCC instrumentation reads 3–4 dB *high* throughout the broadcast band—i.e., at least *double*.

The other big problem is the FCC inspectors' methodology. They did make numerous spatially averaged measurements to arrive at the "160.5 percent" average. But to determine which stations were significant contributors, while minimizing downtime, they used a fundamentally flawed technique. They made two spatially averaged measurements with each station powered down, one at a time. They determined each station's contribution by subtracting the average of these two readings from the baseline of 160.5 percent. Although this method is fine for the FM station that was contributing about half the energy, it is virtually useless when trying to quantify the small contributions of the other stations.

In essence, the FCC determined each station's contribution by subtracting a large, imprecise number from another large, imprecise number to calculate a small number.

At a site like Mt. Wilson, the next measurement could easily vary by 10 percent *without shutting any station off.* Calculations were made for one of the stations cited at Mt. Wilson using the FCC-recommended formula. These calculations are normally accepted by the FCC because they are conservative—calculating the field levels at two meters above the ground. This calculation showed field levels of about *one quarter* of what the FCC cited.

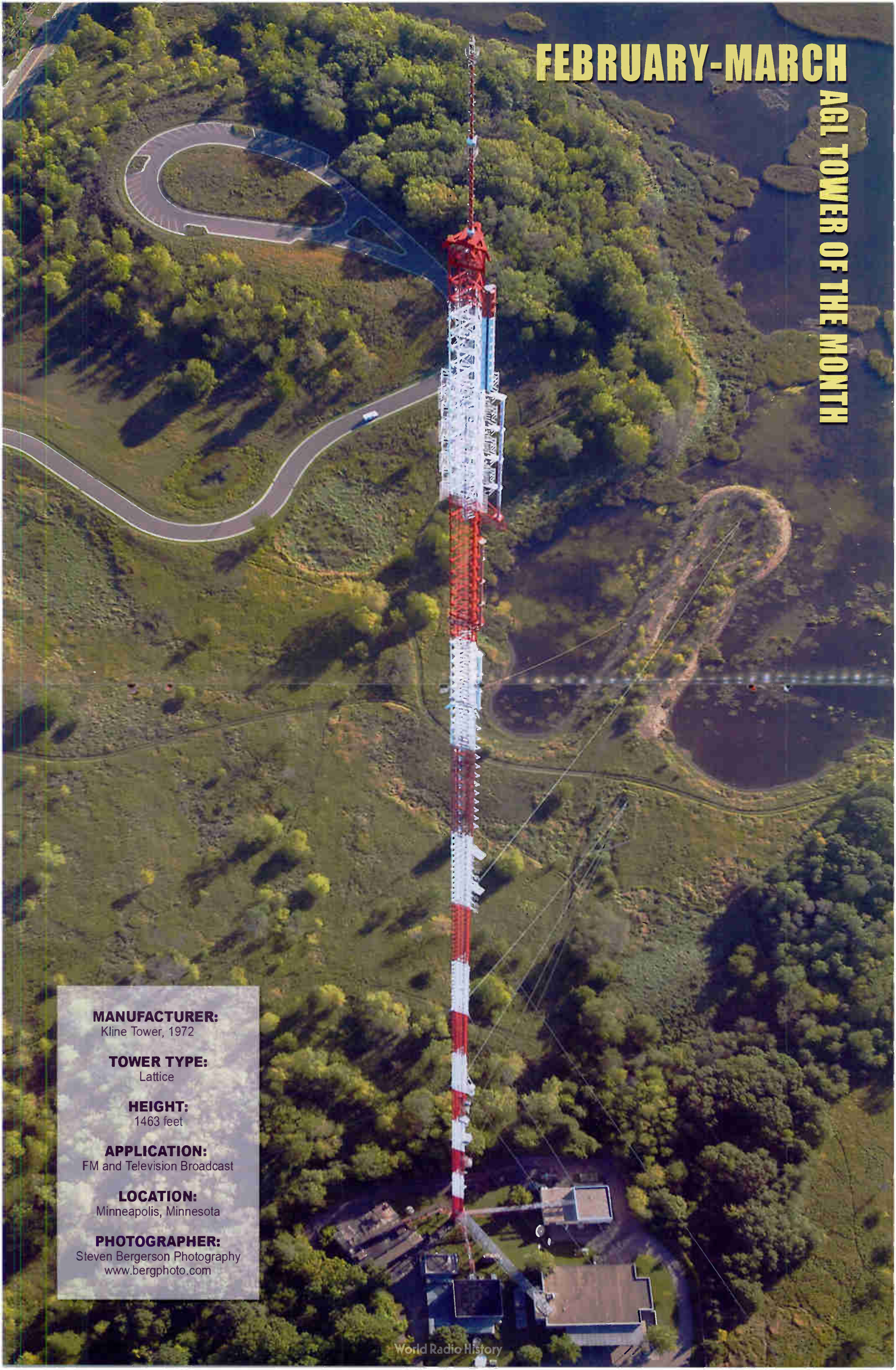
'License renewed—or revoked?

As late as December 2005, FCC inspectors were using the same bizarre method at a big antenna farm in Boise, Idaho where there are more than 30 stations contributing to the field.

Where does it stop?

Accurately measuring RF fields depends on methodology, equipment calibration and a skills base. Without a proper combination of these factors, misinterpretations will defeat the purposes of establishing RF safety and ensuring regulatory compliance. **agl**

Strickland is president of RF Safety Solutions, South Setauket, NY. His email address is: *RStrick@RFSafetySolutions.com.*


FEBRUARY-MARCH
AGL TOWER OF THE MONTH
MANUFACTURER:
Kline Tower, 1972
TOWER TYPE:
Lattice
HEIGHT:
1463 feet
APPLICATION:
FM and Television Broadcast
LOCATION:
Minneapolis, Minnesota
PHOTOGRAPHER:
Steven Bergerson Photography
www.bergphoto.com

Raise th

Every tower is a 'remote' tower. There is no such thing as a 'short' tower. Experience is no substitute for *training*. Never shed responsibility to try to beat the clock—you can't beat the Reaper.

by Winton Wilcox, President & CEO, ComTrain

While attempting to install a transmission line ladder in one piece, a rigger installed the top few bolts and then *tied off to the line ladder* to climb down and finish installing. The line ladder peeled off along with the climber, *causing his death*. This report is unverified, yet plausible.

No structures have been built higher than towers. Communications towers soar to levels more than 2,000 feet high—that's more than *one-third of a mile*. Imagine spending eight or 10 hours each day, suspended hundreds of feet above the nearest floor, wall, window or furniture. You have no ground to rest on, no rocks or logs to sit on. You have no shelter. The professional men and woman who build, maintain and inspect these gossamer structures are part of a special group that faces these challenges.

The explosive demand for wireless services requires thousands of new towers every year. Staying abreast of skyrocketing technology requires that thousands of wireless systems be replaced, renewed, repaired and inspected. The special nature of individuals capable of performing this work, coupled with the increasing need for these workers, draws thousands into this dangerous environment every year.

The benefit of this growth is that the average citizen can make a wireless phone call nearly anywhere in the nation. A consequence of this explosive growth is that some tower professionals lose their lives.

Why? Two causes of tower deaths are *money* and *lack of training*.

Commercial service providers spend billions of dollars on this gold rush. They recruit relatively few experienced tower workers to fill thousand of available jobs. Companies with competent financial skills and abundant technological skills rush into the commercial carrier business. Many don't understand the "plant": the physical delivery system—*the towers*.

Experience falls short

Seldom does a human resource department staff have experience finding

Climbing to construct or to maintain towers, or to add attachments, is complicated by weather *(inset, left)* and structural instabilities *(insets center and right)*. It is a lonely occupation *(right)*, and every work location is 'remote'. *Photos courtesy of ComTrain.*

The NC-DOL Tower Safety Standard

by David G. Sarvadi, esq., and Jeremy W. Brewer, esq.

The North Carolina Department of Labor (NC-DOL) is aggressively enforcing its tower worker safety standard published in 2005. Emulation of this standard could expand to other states.

The *North Carolina Administrative Code* (13 NCAC 07F.0601–0609) addresses hazards, especially related to falls, associated with work on communications towers, and became effective Feb. 1, 2005. On Nov. 1, 2005, a tower services employer was cited by the NC-DOL for failure to provide 100 percent fall protection and for failure to perform and document hazard assessments and pre-climbing inspections.

What the new standard requires

The regulations apply to work on communication towers during construction, alteration, repair, operation, inspection and maintenance. Communications towers are defined as towers over six feet in height used primarily as an antenna, or that host one or more antennas. Where the tower is affixed to another structure (an electrical transmission tower, building rooftop or water tower), the applicable part of any controlling federal regulation (29 C.F.R. 1910.268, 1910.269, or 29 C.F.R. 1926, Subpart V for transmission towers) applies up to the point of access to the communications tower.

Employers must ensure that:

- employees adhere to acceptable conditions of access.
- at least two employees are present, including one competent person, when employees are exposed to fall hazards above six feet.
- a competent person has inspected the tower base for damage, deterioration, structural deficiencies and functionality of safety features before employees climb above six feet.

Employers must ensure that 100 percent fall-protection systems are used prior to employees climbing covered towers. Where adequate fall protection is provided, the regulations do not require retrofitting of communication towers with fall-protection equipment.

Although the standard does require a specific type of fall protection, the rule provides criteria for certain types of fall-protection systems, should the employer choose to use them. Types of fall protection covered under the rule include:

- guardrail systems, conforming with 29 CFR 1926.502(b).
- personal fall-arrest systems, conforming with 29 CFR 1926.502(d).
- positioning-devices systems, conforming with 29 CFR 1926.502(e).
- ladder safety systems, which must comply with 29 CFR 1926, Subpart X.

The standard also requires employers to create and maintain certain records:

- training records.
- medical records and non-ionizing radiation exposure records.
- equipment inspections and testing records (including information related to modifications, repairs, test, calibration or maintenance).

Employers must provide training (and maintain training records) on:

- review of written work procedures.
- hazardous materials training for employees who handle or use flammable liquids, gases or toxic materials.
- fall-protection training.
- hoist-operator training (for hoist operators).
- RF training for employees exposed in excess of the MPE limits stated in 47 C.F.R. 1.1310.
- retraining, when necessary.

What the citations covered

In the Nov. 1, 2005, NC-DOL citations, the employer was cited for failing to complete a number of the newly required tasks. Among them were:

- no hazard assessment.
- no pre-climbing planning and inspection or documentation of same.
- failure to ensure that fall-protection attachment points met specified requirements.
- no documented emergency-rescue procedures.
- failure to assure that attachment points were secure.
- failure to provide two employees on site with first aid/CPR.

What employers should do

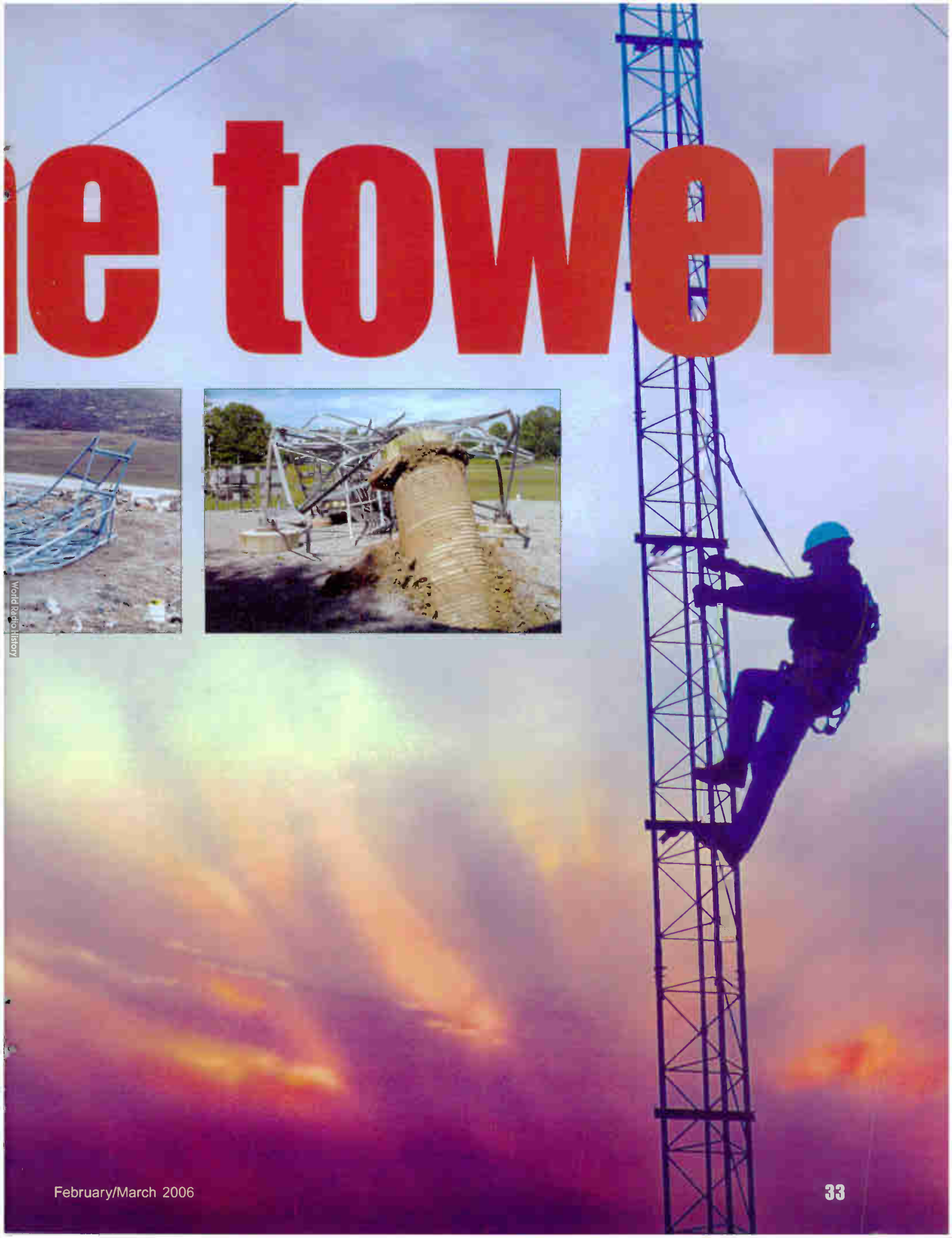
Tower construction and service employers operating in North Carolina must update their safety and health practices to incorporate these recent changes and modify their written training programs and compliance plans accordingly. The standard applies to any employer whose employees perform work on communication towers higher than six feet.

Other states, or OSHA, could look to the North Carolina regulations to establish elements of a general-duty-clause citation. While the general-duty clause does not require employers to adopt the practices described in the North Carolina standards, employers in the tower construction and maintenance industry could be charged with *knowledge* of the standard in any case brought in other states. Accordingly, employers should consider whether its employees and contractors should follow these procedures in other states.

Preparing plans and documenting compliance with these requirements may appear to be a daunting task, but once the initial effort is complete, much of the compliance effort will be simply to repeat certain practices and procedures on every job. agl

Sarvadi is a partner, and Brewer is an associate, at the law firm of Keller and Heckman, Washington, DC.

e tower




Rescue procedures for extricating a sick or disabled tower climber are an integral part of proper training. *Photo courtesy of ComTrain.*

tower workers with the necessary skills. Few corporate safety directors and trainers are familiar with what it takes for riggers to work and maneuver on towers like spiders on a web. Middle management and field management personnel charged with raising the tower may have little or no experience with these unique structures.

Project managers, on average, simultaneously juggle as many as 150 new tower builds or replacements. Average tower construction companies have 15 good tower workers on staff. This means each project manager must work with several contract companies, seek additional contractors, find a construction company with more capacity or combine these approaches to fill the need.

New companies also are entering the tower construction business. Although the growth is good, if established companies find it difficult to recruit trained staff, where can new companies hope to find help? The shortage of trained workers cannot be solved by money alone.

Interestingly, the construction demand is drawing companies from other trade disciplines into the tower industry. For example, electrical contractors hired to wire a few rooftop installations or to install the utilities at a tower site have been asked by their customers to build "a few small towers."

Those who use the phrase "small towers" reveal some ignorance. Although it may be sobering to consider working on a 2,000-foot tower, and a candidate may hesitate, when a tower is described as "small," maybe it seems less intimidating. For example, a "cell tower" is seen by many carriers, contractors and the public as something smaller, less sophisticated and less dangerous than a broadcast tower. They might be smaller, and they may be less sophisticated, but they are no less hazardous to the worker.

For example, a seasoned professional engineer charged with inspection and safety responsibility for a large number of towers spent years trying to convince his client that several were decaying and needed repair or replacement. During safety training, he taught crews to inspect towers thoroughly before climbing.

One crew leader, while checking the guy-wire anchors before a climb, told a worker that the engineer had said, "Check the anchors on a guyed tower."

"*How* should I check them?" the worker asked.

"Feel them, look at them, and kick them," the crew leader laughed as he *kicked* the anchor, which pulled out of the ground, and *the tower fell over*. The laughter stopped.

The engineer marked that site and several others with signs warning against climbing the towers. The client was furious. The client told the engineer he was being ridiculous; that the tower was *only 25 feet tall*, and he demanded the engineer attend a meeting at the corporate headquarters.

The engineer told the client that he would be glad to attend, and he would agree with the client that the warning was ridiculous if the client would do him one favor. The client agreed, and the engineer said: "When I get to your office, you and I will go to the roof of the building"—only a two-story office building—"and *you will jump off. Since it is only 20 feet, there should be no problem*."

Without proper training, working on towers is dangerous, whether the work is at the 20- foot or the 2000-foot level. What training is needed? What makes working on towers so different from working on a rooftop or installing ironwork on buildings?

Professionalism and safety

Although some hazards are obvious, others require experience and training.

Two areas of training are critical to *professionalism* and *safety*. Tower workers must have skills to complete the wide array of tasks required in building and maintaining towers. Because the working space on towers is small, and because projects may involve trade skills from more than a dozen disciplines, tower workers are required to be highly skilled and independent.

A simple task on the ground may be complex on a tower. How many tower climbers does it take to change a light bulb? *One.* There is *no room* for other workers to help. On a tower, replacing a light bulb requires the worker to carry the replacement bulb, tools to open the fixture, test equipment to confirm the circuit, products to clean the lens and fixture, and gaskets to replace possibly damaged seals—carry them, that is, maybe hundreds of feet straight up. The worker must know how to open the fixture, how to clean and check the seals and vents, and how to test the circuit to verify that other repairs are not needed.

Consider that this *simple task of replacing a bulb* requires three skills: first, the manual skill to replace a light bulb; second, the electrical skill to use and comprehend voltage-testing equipment; and third, the physical skill to climb hundreds of feet up and down. Imagine the skills required to rig a tower, lift a 300-pound antenna or ice guard 200 feet above the ground, position the device, bolt it in place, test the effectiveness of the installation and de-rig the tower.

Some tower structures have rings or platforms, but generally there is no flat area for worker rest or equipment assembly. Photo courtesy of ComTrain.

Satisfactory training includes lessons about the basic structure of towers. Tower climbers must be able to evaluate whether the structure is safe to climb and work on, given the tasks involved. If the climber in the anchor example had not known enough to inspect the anchors, he might have climbed right up to replace a simple omni antenna, shaking the tower in the process. His work might have pulled the anchor out of the ground, and he could have fallen with the tower, *25 feet*.

Climbing and working on steel communications towers is unlike any other activity. Towers are not built for human occupancy. Fire marshals and building inspectors do not conduct regular inspections. Towers are filled with more and more attachments, and they are sometimes overloaded.

Unique working environment

Clients' requests to mount and operate equipment rarely consider how a climber would reach the mounting location or work in the awkward conditions. Few tools, and little equipment, are designed specifically for use in the self-contained environment of tower work. Tower workers must modify and adapt equipment and tools to perform the tasks. Dropping a wrench—a minor annoyance on the ground—becomes a big problem when working on a tower.

Two climbs on a 200-foot tower, per day, is more than 800 feet of climbing a ladder or, worse yet, climbing alternated step bolts. Leg or knee injuries, cramps and pains are common on such tiring climbs. Other high construction usually offers flat surfaces, such as iron girders and decks, to serve as rest or assembly areas. Towers rarely have any flat work surfaces. A technician must "pack" tools and parts while maneuvering around and standing on surfaces generally no larger than the instep of the foot.

In addition to selecting, modifying and toting tools, climbers must carry and use personal safety equipment. Tower safety equipment has unique requirements. Safety equipment and tools used on towers must be lightweight and portable. Even with lightweight products, the shear bulk and mass demands multi-use tools and equipment. A tower technician must be able to use the same lanyard and connector to attach to small steel bracing or large double-angle steel during the same climb.

In addition to light weight and flexible use, the equipment must not encumber or endanger the climber. A long lanyard dangling beside the legs may hardly endanger someone walking across a deck, but during a tower climb, long lanyards become trip hazards: they catch on bolts, they snag on the knees and they hang up on the feet.

Safety-training seminars and pre-climb safety meetings are essential to minimizing the risks for tower construction and maintenance crews. *Photo courtesy of ComTrain.*

Locking hooks and carabiners ('D' rings) may make more positive connections if they require two hands to open, but tools used on a tower should not require two hands to manipulate. Attachments using chains, pins or fasteners that can be dropped are also inadequate for use on towers.

Even the common hardhat is often inadequate for working on a tower. Simple "bump caps" that rest on the head or even use tightening adjustments are prone to fall off when the worker is suspended on a tower. Most of the inexpensive hardhats can be adapted to a chin strap (a simple elastic band worn under the chin to keep the hat on), but these are uncomfortable, inadequate and distained by most climbers.

Some safety equipment manufacturers understand the needs of tower workers. A few companies have made the effort to develop equipment that works in this intense environment, but much remains to be done.

Even the more conscientious manufacturers have a distribution problem. How can a tower climber find and buy equipment that is workable and efficient for this special profession? Local distributors sell most such equipment, but these outlets rarely have salespeople familiar with the special needs of tower workers or the advantages of various pieces of equipment. Most sales people just know a harness is a harness, a lanyard is a lanyard, and they sell what they have whether it will be used working on a tower, in a man-basket or on a roof.

This distribution problem requires a better-trained buyer. The tower climber must know what works, how it works and what realistic options are available.

All tower work is remote work. Even working on a 200-foot tower in the center of a major city is remote. A worker who is injured or sick at 200 feet straight up is just as isolated and remote as a worker several miles out of town. One often-overlooked and critical element of training relates to what to do if a worker is severely cut, sick or disabled 200 feet straight up. How do you treat the problem? How do you get the climber to the ground? What equipment is available to perform a rescue? How is it used? What skills are demanded?

The consumer increasingly demands portable, instant communications. Money is rushing into the wireless industry to meet this demand, and during the next 15 or 20 years, the pressure will generate an intense need for tower work.

Companies with no respect for what it takes to build and maintain towers find themselves delayed by the permitting process and constrained by design and budget limitations. When the time comes to build, the pressure to activate new sites may lead them to push the envelope of safety.

Most tower clients do not have tower workers on the payroll. They do not allow employees to climb towers. The client just wants to "raise the tower, activate the site and sell minutes or excess capacity." Many project and contract managers are compensated by bonuses based on meeting or exceeding completion dates that are increasingly unrealistic.

Facing the shortage of available contractors, many companies hire a general contractor and let "the general" fight the resource issues. Yet large general contractors themselves rarely have employees who climb towers. They subcontract parts of their large projects. In turn, the subcontractors rarely have the manpower or equipment to meet these inconsistent, short-term projects, so they subcontract parts of *their* work to additional small companies. Who evaluates the *actual* workers, and how are they evaluated? Where are the money, support, time and effort to provide training?

Cheap, fast construction and time pressures coupled with new and poorly trained workers represent a *formula for disaster*. It is the responsibility of all who are involved in the wireless industry to employ safe practices and to pursue professional standards in workmanship.

Some of the resources for information and training related to tower workers include associations such as:

- National Association of Tower Erectors.
- Energy Telecommunications and Electrical Association.
- Tower-pro, a Yahoo group maintained and populated by nearly 2,000 tower workers.

Tools/equipment distributors include:

- Midwest Unlimited.
- Bunch Company.

Industry training specialists include

- ComTrain.

Manufacturers of safety equipment appropriate to tower work include:

- Buckingham Mfg.
- DBI/SALA.
- Elk River.

Suppliers to the industry include:

- Andrew.
- PolyPhaser.
- Anritsu.

agl

NOCs: One Way to Save—or Make—Money

The days of contact-closure alarms are giving way to a world of intelligent systems that make remote-site monitoring a moment-by-moment snapshot of systems status.

by Donald Koehler

A Network Operations Center (NOC) is a common management tool used by companies with wide-area operations or large equipment pools that must be monitored. NOCs also provide benefits to companies, with multiple sites, that wish to provide a low-cost, centralized oversight of power, lighting, fire, climate control, intrusion or other site parameters. A NOC can serve as a customer contact point for technical issues, can coordinate dispatch of maintenance staff and can provide up-to-date information to large customers when an outage has affected service.

Large to mid-sized companies provide a "24/7" monitoring staff, (with maintenance staff typically on-call), to maximize network uptime. Smaller organizations can benefit from the use of open-source tools that allow semi-automated monitoring of key alarm or equipment-state indicators. Small operators can save on labor costs by counting on software intelligent agents to perform after-hours callouts to respond to alarm conditions, via email, paging or SMS. Open-source tools reduce costs in several areas while increasing flexibility of workers.

Linux-based systems enable low-cost 'real estate' for monitoring network operations.

Beyond command and control, modern NOCs offer opportunities to save or to produce revenue for the core site management business. This activity is enhanced by alternate technologies and open-source operating systems and applications, in combination with emerging "lights-out management" technology. Major service providers use these strategies, and others, to save labor and to reduce travel costs while providing greater flexibility to operations personnel. Larger system operators can apply the value in these strategies to the "bottom line." Smaller system operators can use the same techniques to leverage the workforce they have now and to provide unmanned after-hours monitoring and alerting for service staff.

Operations costs

A close examination of running a NOC shows that costs lie in several areas. Labor expense will account for about 70–80 percent, or more, of operations costs. Other NOC costs are related to telecommunications or remote connectivity and, interestingly, *software license fees*. These fees can be substantial, and while the fees may pay for some support or upgrade services, they are an annual expense that seems to grow larger each year.

Another hidden cost, loss of supply-chain vendors, can complicate an already murky support picture. Worse, if the vendor goes under and leaves you with an "orphaned" application, what can you do? Support and legal (third-party) issues cloud the continued use of such a product, often forcing the system operator to move to a different, perhaps more costly, application option. Even if the software platform is picked up by another vendor, your prior investment is usually lost.

Let's look at how GCI, headquartered in Anchorage, AK, saves money with open-source applications. GCI is a mid-sized (1,300 employees) communications provider that has suffered through the previously mentioned issues and woes over the years in running a network-wide NOC. It developed, and then implemented, some excellent programs to avoid these common traps. This activity saved money and improved service to customers—something the stockholders must love. The tools used by this NOC provide many lessons for other service providers, no matter the type or size of system supported.

Monitoring tools

The GCI NOC technicians use customized, multiscreen desktops units running—LINUX. Yes, LINUX. In this case, the Mandriva (formerly called Mandrake) distribution in use will easily support as many as six screens running off of a single PC. The ability to run multiple, concurrent processes is one of the key reasons LINUX was chosen to support this NOC monitoring scheme. LINUX provides flexibility, fault tolerance, a wide range of application support and, as noted earlier, low cost.

The PCs—generic, low cost units—are standardized and were purchased in bulk from a small-business vendor willing to discount. Desktop computers become, at this point, a commodity, so "no name" machines are more than adequate for this use. Spares are bought in small quantities and the hard drives are imaged from a master, so maintenance downtime is minimized, should an outage occur. Any field-replaceable unit (FRU) from one PC will fit any other PC. Systems are set up to be as similar to each other as possible. Any of the more common replacement parts can be quickly procured at a local PC sales outlet.

Servers supporting this NOC have, for the most part, LINUX as the operating system, with most applications being Web-enabled. Other specialized servers run Solaris UNIX, with a scattering of Windows-based machines filling out the roster. In moving to a LINUX/Apache/MySQL/PHP (or "LAMP") environment, initial costs are low, with license fees either absent or nearly nonexistent—and the applications developed or modified belong to the company. This reduces the chances of being stuck with orphaned applications. Any new, system-critical software is purchased with a requirement that the vendor put the code into "escrow" to allow continued (albeit, internal) support and use, should the vendor cease doing business.

The other cost-saving measure is the use of an open source application to connect the desktop PCs used by the NOC workers to the servers supporting a tool (monitoring application). This allows each shift worker to pull up just the tools needed by the worker on separate screens, and the monitoring tool setup can vary from position to position. A couple of "anchor" monitoring positions exist because of specialized monitoring equipment. Wideband microwave spectrum analyzers, for example, are hardwired a specific location or work position. GCI's NOC manager says this flexibility is the key to real cost savings and worker productivity. By using flexible tools, the NOC can go from a busy weekday dayshift, with many workers, to a weekend environment with few workers, by allowing the workers on a shift to pull in the key tools they need to operate "their" workstations and still cover the entire network.

Equipment sites are outfitted with low-end servers that, in turn, report to a centralized server near the NOC location. This reduces overhead (nonrevenue) data traffic by processing much of the alarm information on site, thereby reducing communications bandwidth costs. As a safety measure, each site is equipped with a dial-out-only modem for backup connectivity.

If an alarm is reported at a remote site, the maintenance technician or engineer can telecommute to the site via a variety of secure TCP/IP links. Most of these servicers have company PCs at home, so "commute time" is essentially zero. If the problem can be resolved or stabilized remotely, then travel in bad weather is reduced or eliminated.

Intelligent design and SNMP

Much of the communications equipment sold today, and projected for the near future, is considered "intelligent" or interactive. Gone, for the most part, are the days of dry contact-closure alarming as the only source of data. Today, if equipment does not support some type of remote, interactive monitoring and control, the vendor will find no buyers. An increasingly popular form of interaction with communications and related support equipment is via Simplified Network Management Protocol (SNMP). Once found mainly in the routers and switches that power modern wide-area networks, SNMP is now one of the powerhouse protocols used widely by many equipment vendors. SNMP "traps" can provide detailed status, send alarms and provide advanced troubleshooting diagnostic data.

SNMP management requires vendor-supported datasets, or at least vendor use of a standard Management Information Base (MIB). An MIB,

Learn more on the Web

- To learn more see:
  SNMP basics http://www.onlamp.com/pub/a/bsd/2000/07/27/Big_Scary_Daemons.html
- How to use the command snmpwall to discover what your equipment will deliver:
  http://support.solarwinds.net/Help/MIB-Walk/Overview.htm
- See if your equipment has a MIB on the net:
  http://www.oidview.com/mibs/detail.html?VID=193
- Want to know about OpenNMS?
  http://www.opennms.com/
- Got your JAVA hat on? Try the OpenNMS application:
  http://sourceforge.net/projects/opennms/
- See the software and installation manual.
  If I can do it, you can do it.

often seen a large string of numbers (.1.3.6.1.4.1.2.2.3.6 for example) is the standardized shorthand used to define the parameters and values provided to you by your intelligent equipment. Each string will identify a parameter, and the equipment, when queried with that specific string, will return a value that can be translated into a useful term, such as milliamps or voltage, within the monitoring display application. The full capabilities of SNMP protocols, and the MIBs supporting them, are complicated enough to warrant their own book, but for now, see the links at the end of this article for more information.

GCI has been experimenting with using another open-source SNMP application, OpenNMS, to monitor its server stacks. Initial tests have been successful, tempered with the understanding that there are issues regarding interactions between NetSNMP (the active, or resident, server agent) and the native operating system that require a careful approach. Here, too, open-source applications provide powerful tools with no cost for the software, low initial startup costs and the advantage of being license-fee-free. The Internet has many sites with good "How To" pages on use of these applications, all worth a read.

SNMP is somewhat complicated for a novice, but fortunately help is just a click away. One company that is riding this Open Source wave is the OpenNMS group. They don't *sell* SNMP monitoring software. In fact, they go out of their way to help you get it for *free*. They have spent considerable time in documenting the SNMP monitoring application, OpenNMS, to make it more useful.

What the OpenNMS group sells is *service*. Experts on the OpenNMS application, they offer everything from initial setup, support and training to complete (and remotely provided) day-to-day maintenance of the application as it supports your networked equipment. Tarus Balog, who heads the group, has been with the application from its infancy. He and his group of experts can quickly set up the application for just about any situation. Once they are finished, you pay no year-to-year license fees. You can sign up for ongoing support, but the software itself is free of license entanglements. In essence you own—and control—the application. I have taken Balog's training for SNMP support and can tell you it is first-rate.

A small system operator can take advantage of open-source software to save on startup costs and license fees while increasing worker flexibility and productivity. Applications like OpenNMS allow remote monitoring the capability to have alarm information emailed (or sent via paging or an SMS message) to service staff. There is a galaxy of applications to support monitoring and control needs, with resources like Tarus Balog at the OpenNMS group that can take the hassle out of setup and maintenance. Taking a step to open source is taking a step to the future, a cost-effective future for a NOC. agl

Koehler is a telecommunications and computer disaster-recovery consultant based in Anchorage, AK. The author acknowledges David Morris, Larry Whetham, Jim Jarvis, George Molczan, Tony Lewkowski and employees at GCI for access to their facilities and information about Open Source applications.

There is a Spirit in the Woods

Sometimes, good will is better currency than cash. Nextel solved Sherborn's communications problem, along with one of its own, with a collocation site that needed 'only' 23 RFPs on its way to completion.

by Detective John P. Hebb
Sherborn, MA, Police Department

Sherborn, MA, is a quiet residential town 18 miles southwest of Boston. Because of its small-town character, the spirit of community involvement is strong. When units from the Sherborn Police and Fire Rescue Departments were dispatched to an elementary school on Dec.12, 2002, for a medical emergency involving a student, the community's curiosity was piqued. When a second call went out for a hazardous materials incident at the school, the level of alarm rose significantly.

Sherborn's public-safety departments are small. The fire department is a "call department," and the police department often works with minimal staffing. The dispatch center is run by the police department and is staffed by one person at all hours. Pine Hill School, where the emergency occurred, is at the end of a narrow, two-lane road. Shortly after the dispatch went out for the HAZMAT incident, the dispatcher was overwhelmed by calls from concerned townspeople wanting to know what was occurring. Parents wanting to extricate their children soon swarmed the school.

Brush Hill is one of the highest points of land between Boston and Worcester, MA. Under a cooperative agreement, Nextel gained a prime location, and the city benefited from improved wireless communications coverage, upgraded equipment and a shelter that blends into the woods.

Out of the tumult... more chaos

All the while, the dispatcher was trying to notify the District Hazardous Materials Response Team and bring appropriate resources to the scene. Units at the scene were also trying to coordinate their activities. It was tumultuous. Eventually, order was restored, the school children were relocated to an alternate site, and the source of the noxious odor, which had instigated all the chaos, was located. By the next day, things had returned to normal.

It was obvious to the first responders who went to the scene that there was a need for a secure form of communications to prevent public panic and to allow a free flow of information. The police and fire departments turned to

Nextel Communications, mainly for the Direct Connect feature. This allows cell phones to also act as secure walkie-talkies. Shortly after beginning to use the units, it became apparent that there were coverage limitations—"dead spots"—where the phones would not work.

I spoke with members of the Nextel organization and learned that the company had been trying to place a tower in Sherborn for several years. Our coverage problems would not be resolved until a tower location was found. I asked if they would be interested in collocating equipment on the town's antenna tower. Yes, Nextel was highly interested.

Honing the tools of reciprocity

Police Chief Gary Hendron and I approached the town government with a proposal. Nextel would replace our equipment shed and antenna tower if the company could collocate equipment on the tower. The town's existing tower was in poor shape and needed replacement. The equipment shed was a dilapidated storage container. The tower and shed were installed in the early 1990s. The shed was rusted-through in spots and infested with insects and rodents. It lacked adequate ventilation for hot weather. Radio failure was common because of equipment overheating.

The equipment was in a Town Forest, bordering a popular walking trail. When any kind of project is proposed in a forested area, it raises environmental concerns. A process began to begin the project, including many meetings with various town boards and commissions. A Request for Proposals (RFP) was generated and submitted for review—a *lot* of review. By the end of the project, there were 23 revisions of the RFP. I had volunteered to write the RFP and ended up doing all the editing. Blessing was received from all the town boards involved, and a plan was presented during the annual town meeting. The plan was greeted with unanimous approval. The RFP was then issued to interested parties.

The shed was rusted through and infested with insects and rodents. It lacked adequate ventilation for hot weather. Radio failure was common...

Nextel was awarded the contract for the project. In the end, Nextel built a new shelter and equipped it, installed a new monopole tower and removed the old equipment. Nextel pays rent to the town government for the ground space. A 20-year lease was signed. Construction began in the spring of 2005, and the facility was completed in October 2005. The facility is one that the Sherborn can be proud of. The shelter is of cinder block construction sided with red cedar shakes. Shutters on the building simulate closed windows. The building is climate-controlled, fitted with security alarms and equipped with a stand-by generator. It is state-of-the-art.

In return, Nextel was allowed to place its equipment in a prime location that is one of the highest points of land between Boston and Worcester, MA. Sherborn has also gained a secure, redundant communications system for its public-safety departments. The combination was ideal for the company and the town. agl

Detective Hebb, a 27-year veteran of the Sherborn Police Department, also serves as a member of the town's Communications Committee and the local Emergency Planning Committee. He was the project coordinator for the Nextel project.

Antenna Arrays: Impedance Matching

Use quarter-wave transmission lines, carefully selected, measured and cut, to match impedances and combine antennas into phased arrays.

by Harold Kinley

To achieve gain, multiple antennas are connected together into what is called an *array*. When connecting multiple antennas to form an array, two factors must be taken into account: *phasing* and *impedance matching*. This article deals with the impedance-matching aspect. All of the examples herein are for 50Ω systems.

To transform impedances in antenna arrays, quarter-wave (λ/4) transmission lines of the proper impedance are often used. The formula for quarter-wave impedance transformation is:

$$Z_O = \sqrt{Z_1 \times Z_2}$$

where Z_O is characteristic impedance of quarter-wave matching cable, Z_I is the input impedance and Z_2 is the load impedance.

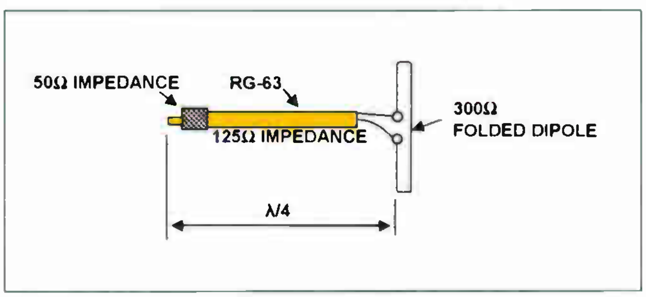


Figure 1. A 300Ω folded dipole can be matched to a 50Ω system by using a λ/4 matching section made of 125Ω RG-63 coaxial cable.

Figure 1 depicts a folded dipole connected to a 50Ω system. Because the folded dipole has a theoretical impedance of 300Ω, it is necessary to transform the impedance to 50Ω. Substituting these values into the formula, we find that a quarter-wavelength of cable with a characteristic impedance of 122.5Ω will transform the 300Ω antenna impedance to 50Ω. A coaxial cable that is nearest 122.5Ω is RG-63. This cable has a characteristic impedance of 125Ω and is about the same size as RG-8 coaxial cable. Any odd multiple of quarter-wavelength can be used in this application—three-quarter, five-quarter, etc. If a quarter-wavelength line is used, the length of the line is determined from the formula:

$$L = \frac{246}{F}$$

where L is length of cable in feet and F is frequency in megahertz. At 160 MHz, the cable length would be 1.5375 ft., or 18.45 inches.

Another factor must be taken into account: *velocity factor*. If the velocity factor of the cable is 0.8, the figure above must be multiplied by 0.8. In the above example, the quarter-wavelength was found to be 18.45 inches. Multiplying this figure by the velocity factor of 0.8 yields a figure of 14.76 inches. If, for practical reasons, a longer cable must be used, the matching cable can be three-quarter wavelength, five-quarter wavelength or any other odd multiple of one-quarter wavelength. If three-quarter wavelength cable is used, the calculated quarter-wavelength cable is multiplied by 3. In the above example, the three-quarter wavelength cable would be 3 × 14.76 = 44.28 inches.

To increase the gain of the antenna or to achieve a particular radiation pattern, multiple dipoles or even multiple antenna arrays can be connected to a single 50Ω feedline by using the proper impedance-matching techniques. A couple of examples are discussed here. In these examples, the red lines are of critical length. The green lines are not length-critical.

Figure 2 shows how two folded dipoles are connected to form a vertically stacked array. The caption describes how the matching sections and parallel connections at the tee-connector produce an input impedance of 50Ω at the input to the tee-connector.

Figure 3 shows four folded dipoles stacked vertically. All cables are 50Ω. Cables shown in green are not of critical length, but must be the same electrical length. Cables shown in red are of critical length and must be the same electrical length.

Sometimes, it is desired to maintain a balanced connection to an antenna and still be able to use coaxial (unbalanced)

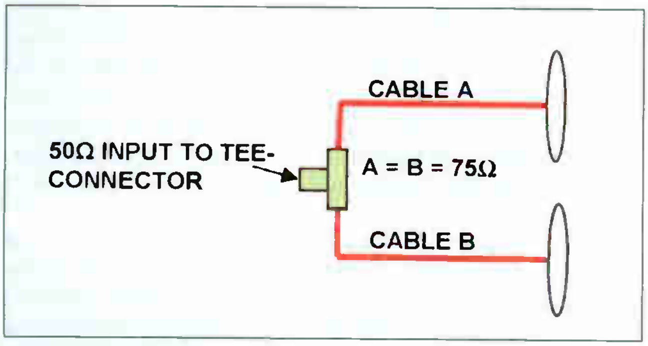


Figure 2. Two folded dipoles, stacked vertically, form an array with more gain than a single dipole. The feedpoint of each is 50Ω, provided by an internal matching section, as in Figure 1. The ends of the λ/4 cables, A and B, must be 100Ω where they parallel-connect at the 'T'. These two 100Ω impedances produce a 50Ω input to the 'T'. To transform the 50Ω feedpoint impedance at each dipole to 100Ω at the tee connector, a 70.7Ω λ/4 line must be used. The nearest available coaxial characteristic impedance is 75Ω, close enough for practicality. Cables A and B can be any o*dd* multiple of λ/4, but if the dipoles are fed in phase, the cables must be of equal length. Velocity factor must be taken into account.

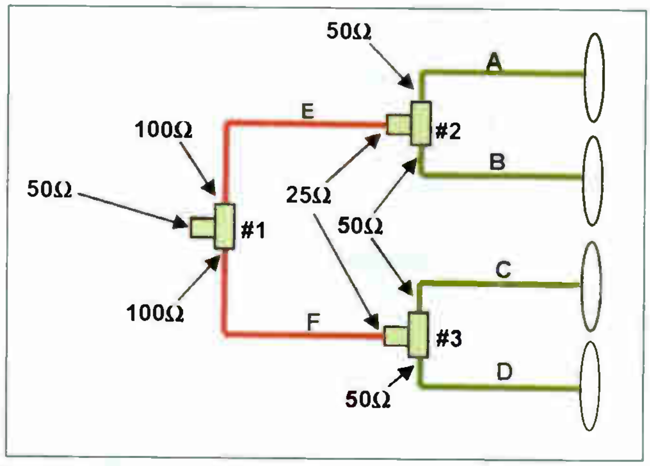


Figure 3. Four folded dipoles stacked vertically. Assuming each dipole has a feedpoint impedance of 50Ω (provided by the internal matching line), the dipoles can be connected as shown to provide an input impedance of 50Ω at the input to 'T' #1. All four cables must be 50Ω, and of the same length, but they don't have to be λ/4. However, they must have the same *electrical* length, with the velocity factor taken into account. E and F also must be 50Ω cables and should be λ/4, or odd multiples. E and F also must share the same electrical length. Cables should be cut from the same spool to closely match their velocity factors. At 'T' #2, A and B combine in parallel to make the impedance at the input to the 'T' equal 25Ω (likewise for the cables at 'T' #3). It is necessary, then, to make the impedance of E and F equal to 100Ω at 'T' #1, using a λ/4 matching section. With E and F presenting an impedance of 100Ω each at 'T' #1, their parallel combination causes the impedance at the input to the 'T' #1 to be 50Ω.

feedline. In this case, a *balun* (***bal**anced-to-**un**balanced*) must be used. The construction of a 4:1 balun is shown in Figure 4. In the case of a 50Ω system, the balun made of 50Ω coaxial cable will be 50Ω *unbalanced* on one side and 200Ω *balanced* on the other side. Figures 5 and 6 show how such a balun is used in a practical application.

Figure 5 *(page 46)* shows how two balanced 300Ω dipoles are connected to a 50Ω unbalanced system. The balun is constructed as shown in Figure 4. The balanced, 250Ω transmission line is constructed as shown in Figure 7 *(page 46)*. Using the formula for determining the characteristic impedance of a quarter-wavelength matching line, the calculated impedance is 244.95Ω. By combining two coaxial lines of 125Ω (RG-63), we get a balanced line with an impedance of 250Ω. This is close enough to 244.9Ω to be practical. This 250Ω line then transforms the 300Ω impedance of the antenna to 200Ω at the antenna side of the balun. The balun then converts this balanced 200Ω to an unbalanced 50Ω on the other side. A 75Ω, quarter-wavelength coaxial cable then transforms the 50Ω impedance to 100Ω at one of the inputs to the tee-connector. The same is true for the lower side of the two element array. With each side of the tee-connector at 100Ω, the input to the tee-connector is 50Ω.

In Figure 6 *(page 46)*, two sections identical to the arrangement in Figure 5 are stacked vertically to yield a four-element

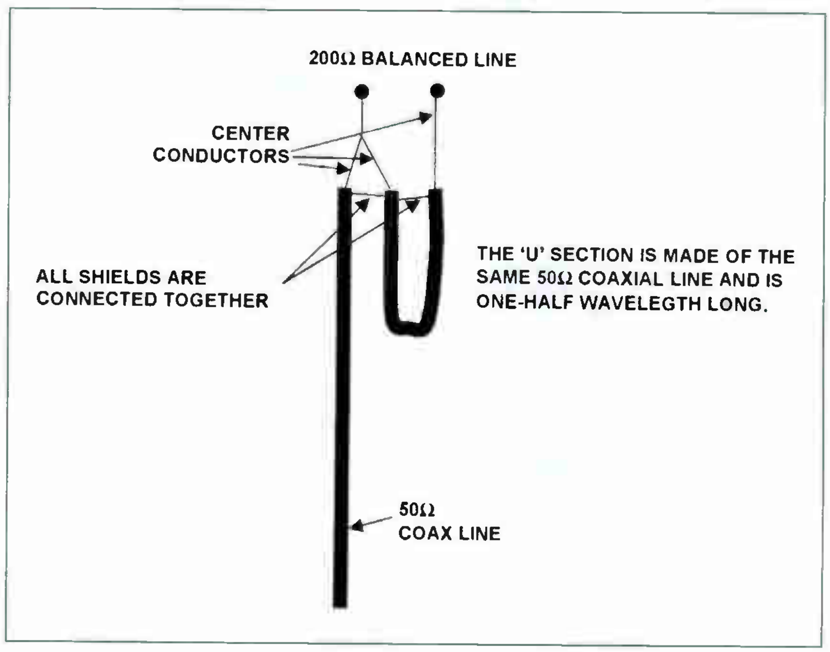


Figure 4. A balun can be constructed of coaxial cable to connect unbalanced coaxial lines to a balanced antenna. The balun shown here has a 4:1 impedance ratio. The 50Ω coaxial unbalanced line is transformed into a 200Ω balanced line.

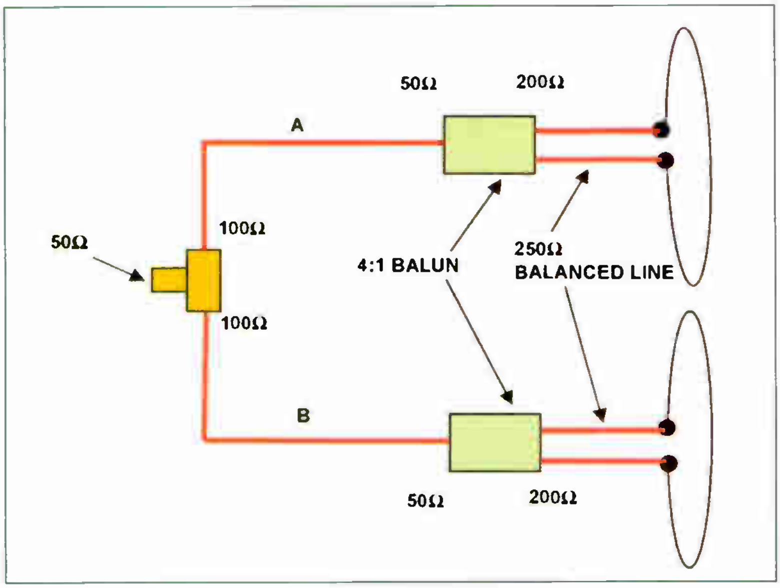


Figure 5: (Left) Here, two balanced, folded dipoles are connected to an unbalanced coaxial line. The baluns are constructed as in Figure 4. Cables A and B should be the same electrical length, 75Ω line. The 250Ω balanced lines are also of critical length (λ/4) to transform the 300Ω impedance of the dipole to 200Ω. Constructing the 250Ω balanced line is shown in Figure 7.

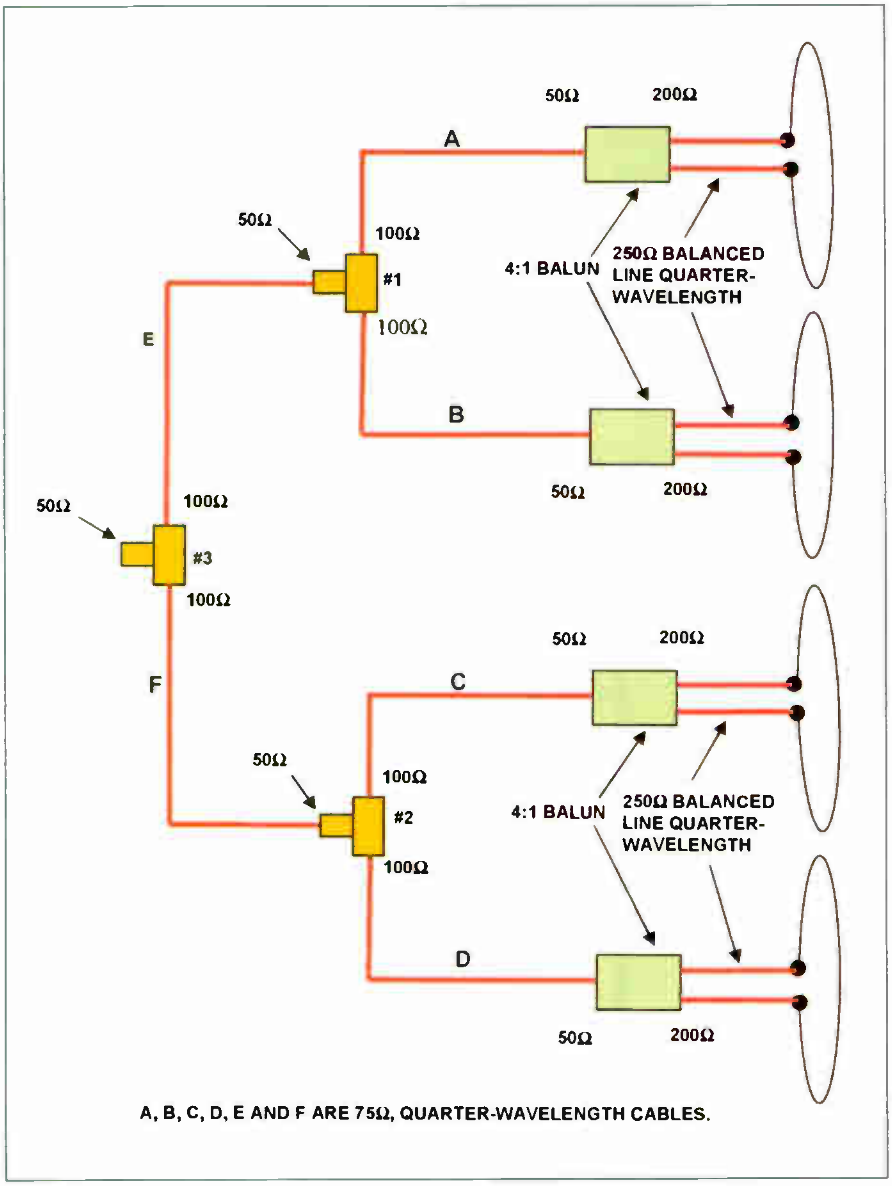


Figure 6. (Lower left) Balanced line connections and impedance matching to 50Ω system. Constructing the 250Ω balanced line is shown in Figure 7. This 250Ω, λ/4 balanced line converts the 300Ω antenna impedance to 200Ω at the antenna side of the balun. The 4:1 balun presents 50Ω at the other side. A 75Ω, λ/4 cable (A, B, C & D) converts this 50Ω impedance to 100Ω at 'T' #1 and 'T' #2. The output side of the tee connectors is 50Ω. Another 75Ω, λ/4 cable connects the outputs of 'T' #1 and 'T' #2 to the inputs of 'T' #3. The parallel impedances of 100Ω each then presents a 50Ω impedance at the input side of 'T' #3.

vertical collinear array. The two sections are then combined into a 50Ω input impedance using another set of impedance-matching cables. These cables are usually called "harnesses." There are many different ways that these harnesses can be configured to achieve the same goal.

Figure 7 illustrates how coaxial cables can be series- or parallel-connected. The series-connected coaxial lines are used to form a balanced, shielded feedline. The characteristic impedance of the two lines should be the same. In the example in Figure 7, on the left, two 125Ω coaxial cables are connected in the series configuration to form a 250Ω balanced and shielded line. The loss in such a configuration is greater than it would be for an "open" line, but the shielding allows the line to be placed near metallic objects without harm.

On the right in Figure 7, two coaxial lines are connected in the parallel configuration. In the illustration, two 50Ω coaxial lines are paralleled to form a coaxial line with a 25Ω impedance. In the case of parallel-connected coaxial lines, the characteristic impedance of the two coaxial cables need not be equal.

By using combinations of coaxial cables in parallel, many different impedances can be configured. For example, two 75Ω coaxial cables in parallel would yield an impedance of 37.5Ω. Parallel-connected 75Ω and 50Ω coaxial cables would yield an impedance of 30Ω.

When connecting coaxial cables in the series or parallel configuration, the velocity factor of the two cables must be closely matched, and the cables must be the same electrical length. Otherwise, signals traveling down the two cables would arrive with the wrong phase relationship at the other end. Partial signal cancellation could result from using mismatched cables. The velocity factor can vary significantly between different spools of the same cable type. Therefore, it is important to try to get the lines from the same cable spool. It is possible that even using cables from the same spool could result in mismatches of the electrical length of the cables.

When cables in the antenna harness are identified as quarter-wave, it means any odd multiple of a quarter-wave. Sometimes, one-quarter wavelength is too short for a practical application and cables of thee-quarter wavelengths or other odd multiples must be used. It is important that cable lengths not be mismatched, because different electrical lengths can adversely affect the antenna *phasing*. That is a topic for discussion next time.

Until next time—*stay tuned!* agl

Kinley, a frequent author of radio telecommunications technical articles, is a certified electronics technician and served for many years as communications manager for the South Carolina Forestry Commission. His most recent book is the *Radioman's Manual of RF Devices* (Noble Publishing, 2004). He is also the author of the *PLL Synthesizer Cookbook* and the *Standard Radio Communications Manual*. Contact information and article and book links are available on his Web site, *www.radiotechnologies.net*.

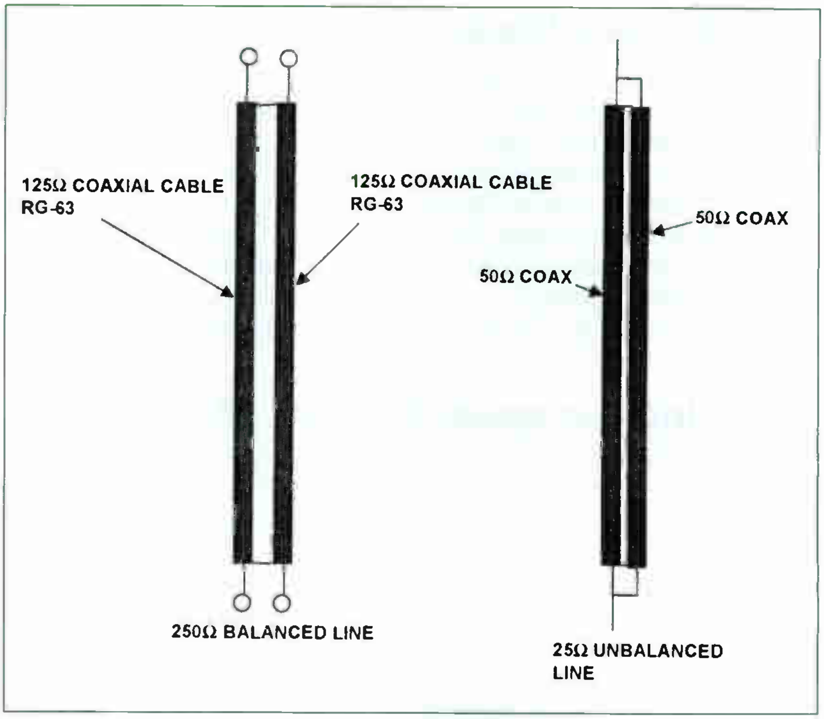


Figure 7. At the left, two coaxial cables with a characteristic impedance of 125Ω are connected to produce a shielded, balanced line with an impedance of 250Ω. The shields are connected on both ends. These are called 'series-connected coaxial cables.' At the right, two 50Ω cables are connected in parallel to form a cable with a characteristic impedance of 25Ω.

Skyway Towers begins operations with $30M equity commitment

Skyway Towers, Tampa, FL, has secured an initial equity commitment of $30 million from Tinicum Capital Partners II and Permit Capital Private Equity Fund in a transaction facilitated by Daniels & Associates. The capital will be used to fund the buildout and operation of communications towers. Skyway began operations in November 2005, one of its two founders, Daniel P. Behuniak, said. Behuniak started the company with Ricardo R. Loor.

Loor brought 15 years of experience in network buildouts and towers with SpectraSite, UNIsite, PrimeCo, Verizon and Nextel. He managed more than 2,000 towers for SpectraSite. Behuniak was president of UNIsite, an operator of over 600 tower sites that was sold to American Tower for $215 million. Behuniak formerly had been president of PrimeCo Bell Atlantic Personal Communications.

"We have a good pair of investors behind us, supporting us for the long term. My goal is to build a company of at least the same size as UNIsite. If I can get beyond that, I would be

Cingular spent $6B on '05 network improvements; $144M in LA

As part of an announcement about the completion of $144 million in network investments in Louisiana, and local support for victims of hurricanes Katrina, Rita and Dennis, Cingular Wireless said that its nationwide network capital expenditure program for 2005 totaled an estimated $6.2 billion. More than $1.5 billion was spent in the Southeast.

In Louisiana, the carrier's investment included additional coverage and capacity via 87 new cell sites, portable generators and back-up batteries, and the rollout of new data features.

"We will remain committed to our customers in Louisiana by meeting and exceeding their needs by continually upgrading and expanding our network and by offering innovative products, services, customer-friendly initiatives and community support second to none," said Gerald Denicola, director of sales for Cingular in East Louisiana.

Among Louisiana locations where the carrier added sites were Baton Rouge, New Orleans, Monroe, Alexandria, Lake Charles and Lafayette.

Cingular said that more than 3,000 of its 5,000 employees in the Gulf States were affected by the storms. It praised the employees for working "tirelessly, and, in many cases, heroically, to support the restoration efforts."

happy," Behuniak said.

The executive explained that this is a good time to begin a tower company because the wireless carrier industry and customers who use wireless services are demanding a higher quality of service. "With the consolidation of Sprint and Nextel, and Cingular and AT&T Wireless, carriers are focusing on filling in the gaps in the networks. That means they need more towers," he said.

Daniel P. Behuniak

Behuniak said that on a case-by-case basis, obtaining approvals for towers has eased somewhat.

"You're starting to see cities and counties where constituents are pressuring them to improve service. The 'connection' has been made. Before, people blamed their cellphones for dropped calls or poor connections. Now, they realize it is the network. They have made the connection between the network and the quality of their service and whether or not the zoning boards and the regulatory bodies are allowing towers to be built.

"There are jurisdictions today where the populace *demands* that their government allows towers to be built. That's relatively new," Behuniak said.

He added that, the closer people live to a tower, the greater the percentage that gets alarmed.

"'NIMBY' continues, but what is happening is that not everyone jumps on board as quickly. It becomes more of a balancing act. It's not just whether the tower is there and unattractive, but if you say 'no' to a tower, there is a price to pay as far as your communications services are concerned," he said.

Behuniak said that financing is critical to a startup. "The cost of every tower ranges from $170,000 to $275,000, by the time you consider zoning, acquisition and putting the tower up. Before you see a penny of revenue, you have to put that kind of money into a tower. It is a capital-intensive business. Debt isn't always available to a company with no revenue from day one. Equity partners are critical," he said.

Whether Skyway would need financing in addition to the initial $30 million commitment, Behuniak said it would be difficult to predict. "The more success we have, the more money we need. If we hit a pace of building 50 towers a year vs. 100 towers a year—you need more financing with 100."

Skyway is acquiring leases in the Southeast, but plans to operate towers anywhere in North America. Behuniak said Skyway's first towers would probably up and on air by 2Q 2006.

VelociTel acquires compliance firm Site Safe from Crown Castle

Wireless infrastructure services company VelociTel has acquired Site Safe, a provider of RF health and safety compliance solutions, from Crown Castle International.


James Estes

"Site Safe is an incredibly complementary acquisition for VelociTel and will expand our service offering, allowing us to better serve our wireless customers," said James Estes, VelociTel's chairman and CEO. "This acquisition reflects the strategic direction that we have paved for the company, greatly enhancing our RF engineering capabilities."

With Site Safe, VelociTel will offer more sophisticated engineering services to augment the wireless infrastructure services that the company currently conducts for virtually all major wireless carriers.

Site Safe provides independent RF health and safety solutions to the wireless telecommunications industry.

VelociTel provides outsourced services to telecommunications carriers and equipment vendors for the planning, design, deployment, ongoing optimization and management of wireless networks.

The company manages large-scale deployments for clients, domestically and internationally.

Waterford Consultants helps with AM tower detuning, E911 Phase II acceptance

Waterford Consultants, Waterford, VA, commenced operations in January, offering a new approach to professionalism in regulatory compliance with an experienced team of industry leaders that will help carriers, site acquisition specialists, tower builders and network engineers make proper, timely and cost-effective decisions to avoid construction delays and unexpected expenses.

Waterford Consultants uses a new, highly automated approach to regulatory and RF compliance services. For example, an online AM screening tool delivers immediate professional-engineer-signed "compliance letters" for negative results or a report with complete results and details of AM stations near a screened site.

The company provides the wireless and broadcast industries with state-of-the-art and cutting-edge technology solutions for AM Detuning, NIER/MPE studies and E911 Phase II acceptance testing and documentation.

The founding member, Richard P. Biby, P.E., announced that Larry Giessman, Mike Britner and Ian Maxwell have joined the company.

"I'm very happy to be reunited with Larry and Ian, who I had the pleasure of working closely with for a number of years at another company," Biby said.

The three had previously worked together in the industry as AM detuning, FCC electromagnetic energy (EME) compliance and FCC regulatory compliance consultants.

Biby has an extensive background in computer-based RF modeling and computerized business-automation solutions. He is also the owner of Biby Publishing, which publishes *AGL* magazine. Ian Maxwell has more than 20 years of experience in RF system design, systems consulting and project management.

Waterford Consultants' Web site, *www.waterfordconsultants.com*, provides an overview of the company, its team and the services it offers.

District Court halts Bird Conservancy's attempts to circumvent the FCC

On Jan. 4, the U.S. District Court for the District of Hawaii granted the FCC's motion to dismiss the case of *American Bird Conservancy et al. v. the Federal Communications Commission.*

The case arose from American Bird Conservancy's action to compel the FCC to consult with the U.S. Fish and Wildlife Service in its registration process for communications towers and antennas. American Bird Conservancy asked the District Court to declare that the FCC is violating the Endangered Species Act by delegating the determination of environmental impact to tower owners and licensees.

The court dismissed the case on the grounds that it did not have jurisdiction over the case because the plaintiffs challenged the general delegation policies of the FCC, which fall under the purview of U.S. Court of Appeals. In addition, the court found that the parties had no private right of action under the Endangered Species Act.

The court emphasized American Bird Conservancy's avoidance of working with the FCC, stating, "Plaintiffs cannot rely on their failure to take the appropriate measures to create an administrative record, and then assert that the lack thereof compels jurisdiction in the District Court."

PCIA President Michael Fitch noted, "This decision confirms that the American Bird Conservancy must rely on appropriate, established procedural avenues.

"This issue is currently pending at the FCC, and PCIA is committed to encouraging further study to determine to what, if any, extent communications structures present a risk to migratory and endangered birds." Fitch said.

Market report offers analysis, economic predictions for antenna-siting industry

Biby Publishing has released its annual market report on the antenna-siting industry, available for purchase at $475 per copy. *The 2006 Tower Market Report*, written and edited by Jim Fryer and Robert H. Schwaninger Jr., includes an in-depth market analysis exploring the growth, size and economics shaping the tower industry. Orders may be placed by telephone at 610-284-9289. Additional information is available at *www.towersource.com.*

Maine considers state plan to expand wireless infrastructure base

An estimated $55 million would have to be spent to build enough towers to deliver broadband wireless services in areas of Maine that lack service. The problem has drawn the attention of Gov. John E. Baldacci and other state officials.

Some see pervasive broadband wireless and cellphone service as one element in a plan to stem the tide of college graduates who leave the state for jobs, to attract more businesses and residents, and to give existing small businesses a way to extend their reach beyond Maine.

The state has nearly completed a program mapping out cellphone and broadband dead zones and is looking at steps it could take to build infrastructure to serve them.

Although some wireless service providers chafed at government competition where population density otherwise supports capital construction, Verizon Wireless welcomed Maine's intervention as a "partner" with private industry in areas of the state where "the economics may be poor," a company spokesman said.

Fire injures tower services company executive

Nancy Nieto, the owner and CEO of TLC Services, Pompano Beach, FL, weathered Hurricane Wilma with little more than a power outage at her home. But on Nov. 1, 2005, a generator at her home exploded while she was checking it. The explosion caused second- and third-degree burns to the upper part of her body. She survived the fire by jumping into a swimming pool.

As of late January, Nieto had returned home from the burn center at Jackson Memorial Hospital and had completed part of her treatment. She was spending an hour a day working from home. Her sister Gina was helping to manage the company, complete projects and handle new business. "We are functioning well. We are up and running as though she were here. Customers are being served," Gina said.

TLC Specialties has been in business for four years and has 12 employees. Its primary service area is in Southern Florida and along the East Coast.

Technicality allows permit

A U.S. District Court judge ruled in December that Duluth, MN, must issue a permit for a 195-foot cell tower, despite the city council's rejecting the request.

The city apparently failed to meet notification deadlines, leading to automatic approval of the permit, despite the eventual vote. The suit was filed by the property owner, joined by Minnesota Towers and American Cellular.

Towerco news

Just when you thought you'd heard about all the possible awards, get ready: There's an award for taking out the best loan. *International Financing Review* gave **Crown Castle International** its "North American Securitization of the Year Award." "We are honored and excited to have received such a notable award," said **Ben Moreland,** Crown's chief financial officer. Crown won the award for the sale of $1.9 billion of Senior Secured Tower Revenue Notes, Series 2005-1. The notes consist of five classes, which are all rated investment grade. The weighted average interest rate on the various classes of notes is 4.89 percent on a fixed interest rate basis. The offering of the notes and the repurchase and redemption of nearly all of Crown Castle's then outstanding high-yield notes eliminated virtually all restrictions on the use of cash generated by operations after debt service and reduced Crown Castle's annual interest expense by $50 million (32 percent).

Ben Moreland

A syndicate of lenders granted **SBA Communications** a senior secured revolving credit facility valued at $160 million. GE Capital Markets is the lead arranger and bookrunner; GE Commercial Finance serves as the administrative agent; TD Securities USA serves as co-lead arranger and syndication agent; and Deutsche Bank Structured Products and Lehman Commercial Paper serve as co-documentation agents. The new facility replaces the SBA's prior credit facility, which was assigned and became the mortgage loan underlying the company's $405 million commercial mortgage-backed securities issuance.

David Grain has exited **Global Signal** as president "to pursue personal and other business interests," a release from the company reads. **Wesley R. Edens,** chairman and CEO, took the additional title as president. "We appreciate David's efforts on behalf of Global Signal and wish him well. I have the highest personal and professional regard for David and thank him for all his contributions and service to Global Signal," Edens said. Grain added, "From the time I joined Global Signal three years ago, the company has more than tripled its asset base and market capitalization and today is one of the leading cell tower companies in the United States. I believe now is the right time for me to move on to other challenges, and I leave with total confidence in the future of Global Signal." Global Signal owns, leases or manages 11,000 towers and other wireless communications sites. Global Signal is organized and conducts its operations to qualify as a real estate investment trust (REIT) for federal income tax purposes.

David Grain

TowerCo, which develops, owns, and leases wireless communications towers, has raised an additional $30 million of equity from Soros Strategic Partners, bringing total equity capital committed to the company to $60 million. TowerCo was founded by Tailwind Capital and management in September 2004. **Richard J. Byrne,** CEO of TowerCo, said, "The additional equity will help us accelerate our tower development activities." TowerCo ended 2005 owning and operating 221 towers. Additionally, TowerCo has an exclusive right to build and buy towers for **Nextel Partners,** for which it expects to purchase or develop 300 wireless communications towers through 2008. New York-based DH Capital served as financial advisor to TowerCo.

Optasite closed a $65 million credit facility at the end of 2005. GE Capital Markets was the lead arranger and bookrunner for the facility and led its syndication with GE Commercial Finance—Global Media & Communications serving as administrative agent. Participating institutions included Rabobank serving as syndication agent, the Corporate Finance Group of Orix USA and Webster Bank. "We're thrilled to have GE as a financial partner to Optasite. GE has a strong track record of successful financing in the tower industry and we greatly appreciate the confidence which they and their syndicate partners have shown in Optasite," said Beau Paradowski, Optasite's chief financial officer. Optasite has about 200 towers and focuses on tower acquisition and development. The company currently has an eastern presence and is expanding its footprint across the United States. Optasite is funded by Centennial Ventures, Columbia Capital and Highland Capital Partners.

Global Tower Partners, Boca Raton, FL, bought 38 towers from **Shared Tower Sites** on Nov. 30, 2005, and will purchase another 209 towers from **TCP Communications** under an agreement announced in January, along with 24 more TCP tower sites under construction. The two transactions bring the number of towers that Global owns close to 2,000, along with another 5,400 sites that it manages or leases. Media Venture Partners, San Francisco, represented Shared in its transaction with Global. The terms of the transactions were not disclosed.

Association news

Robert S. Foosaner, senior vice president of government affairs and chief regulatory officer for **Sprint Nextel,** has joined the board of directors of **PCIA—the Wireless Infrastructure Association.** PCIA President **Michael Fitch** said, "Bob's extensive experience at the highest levels in government and industry make him an outstanding addition to the board." Foosaner is responsible for the representation of Sprint Nextel in regulatory and legislative matters. He had the same role with Nextel Communications, where he led the effort to resolve CMRS/public-safety interference at 800 MHz with an exchange of spectrum at 700 MHz, 800 MHz and 1.9 GHz. "Bob's carrier

Robert Foosaner

perspective will be extremely valuable to the association and we look forward to working with him on the Board," said PCIA Board Chairman **Jeffrey A. Stoops,** president and CEO of SBA Communications. During 20 years with the FCC, Foosaner worked in regulation, policy, enforcement and international activity and served as a bureau chief responsible for radio services and most of the FCC's licensing responsibility.

PCIA—the Wireless Infrastructure Association has named **Anne McFadden Perkins** as its manager of industry affairs. She previously was regulatory affairs director at the Satellite Broadcasting and Communications Association, and before that she was a special assistant to FCC Commissioner Jonathan S. Adelstein. At PCIA, Perkins will build and maintain industry relationships with partner and government agency staff, interacting with the FCC, FAA, state and local governments and other federal agencies. She will work with PCIA members to plan, formulate and recommend policies and programs to further the objectives of the wireless infrastructure industry. Perkins earned a JD from the Columbus School of Law at Catholic University in Washington and has a BA in Government and Philosophy from the College of William and Mary in Williamsburg, VA. She is a member of the Federal Communications Bar Association and the Maryland Bar.

Business activity

Bird Technologies Group, Cleveland, has entered into a partnership with Sydney, Australia-based **RF Industries (RFI)** to sell high-performance base-station antennas in North America. RFI makes low-PIM (passive intermodulation) base-station antennas to fit site-management requirements for digital mobile radio used by industry and by homeland-security and public-safety agencies. Bird will market and sell; RFI will engineer, configure and manufacture the latest in low-PIM-rated base-station antenna offerings. Bird CEO **Mark Johnson** commented, "Bird and RFI have had a successful relationship over a 20-year period, and this most recent collaboration is a logical extension of our continuing efforts to reliably support critical public-safety needs."

Citing increases in material costs for metals and petrochemicals, **Times Microwave Systems** increased prices about seven percent on Jan. 9 for LMR cables, connectors and accessories. Prices for individual items now are higher, lower or unchanged, so Times is making a revised price list available at *www.timesmicrowave.com/telecom/pdf/lmr_price_list_2006.pdf.*

Municipal sites

The athletic field at Monacan High School, **Richmond, VA,** will sport two replacement light pole towers with cellular antennas on them if the Chesterfield County government grants a lease to **Omnipoint Communications.** The county's tower-siting policy allows cell tower placement on school property. The county collects $320,000 in annual rent from cell towers already in place.

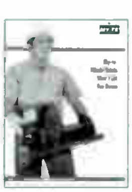
It's a cell tower. No, it's an *obelisk.* **Sprint Nextel** will spend as much as $400,000 to build a 35-foot obelisk resembling the Washington monument and an observation deck—plus $2,000 per month rent—all to be able to house cellular antennas on coveted land that will be developed as a botanical garden in **Vista, CA.** The botanical garden, once projected to cost $50 million, was scaled back to $5 million, and then the city government granted Sprint a permit to locate a facility within it. A representative of the garden's board of directors said he was pleased with Sprint's flexibility in accommodating proposals to disguise the facility, which ranged from a palm tree to a windmill to, ultimately, the chosen obelisk design.

NextG Networks plans to install neutral-host distributed antennas on as many as 59 city-owned poles in **Chicago** with permission granted by city committees acting under authority of a city ordinance. The poles are in the central business district. The city will receive an annual fee of $1,500 for every light pole and $3,000 for every traffic signal pole.

Siting news

Community Wireless Structures won approval to build a 170-foot tower to rent antenna space to **Cingular, Verizon** and **T-Mobile** in **Potomac, VA.**

Omnipoint won approval from the city council in **Springfield, MA,** to add 10 feet to a 135-foot cell tower and to install six antennas inside a bell tower at Trinity Church. agl



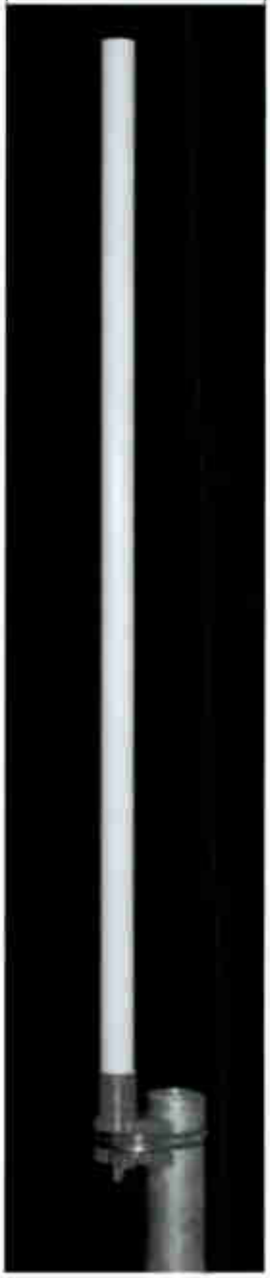

GO!
Visit AGL magazine
at NATE in Orlando, FL
Feb. 13–16, 2006
Booth No. 724
Go to www.agl-mag.com and register
your subscription to keep AGL coming

professional directory

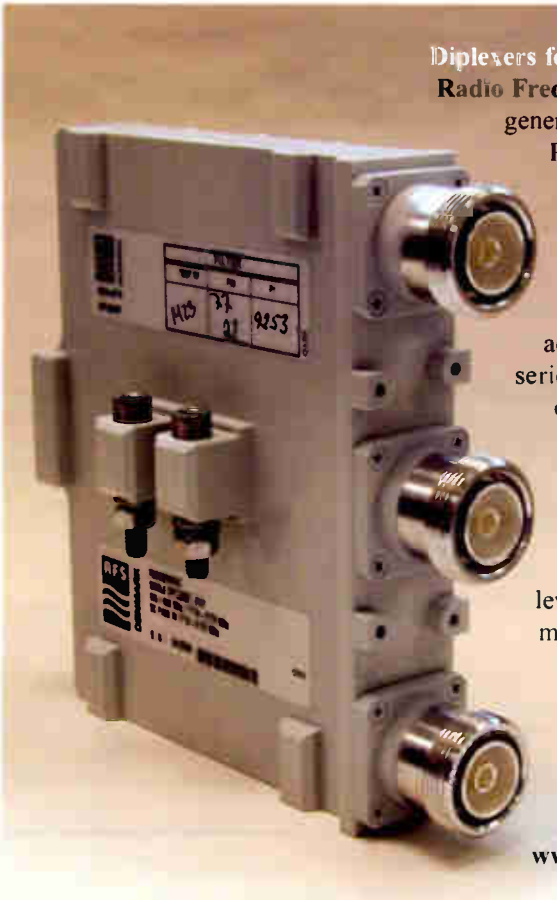
Path-design software
HDPath from **SoftWright** is RF software for point-to-point path design. Users can select any two fixed facilities and see details of the path. Studies such as reflection analysis, antenna heights, path clearances and shadow studies can all be performed within one screen, assuming an existing software module license.
www.softwright.com

No-solder Type N male connector
An improved no-solder EZ crimp connector for LMR-200 and LMR-200-LLPL cables, the EZ-200-NMH-D (3190-1918) is available from **Times Microwave Systems.** The connector features a combination hex/knurl coupling nut to allow tightening by hand or wrench. A tri-metal surface plating eliminates tarnishing while maintaining electrical performance. A ridged landing area on the aft end affords a better grip and sealing of the heat shrink boot to provide improved strain relief and weather sealing.
www.timesmicrowave.com

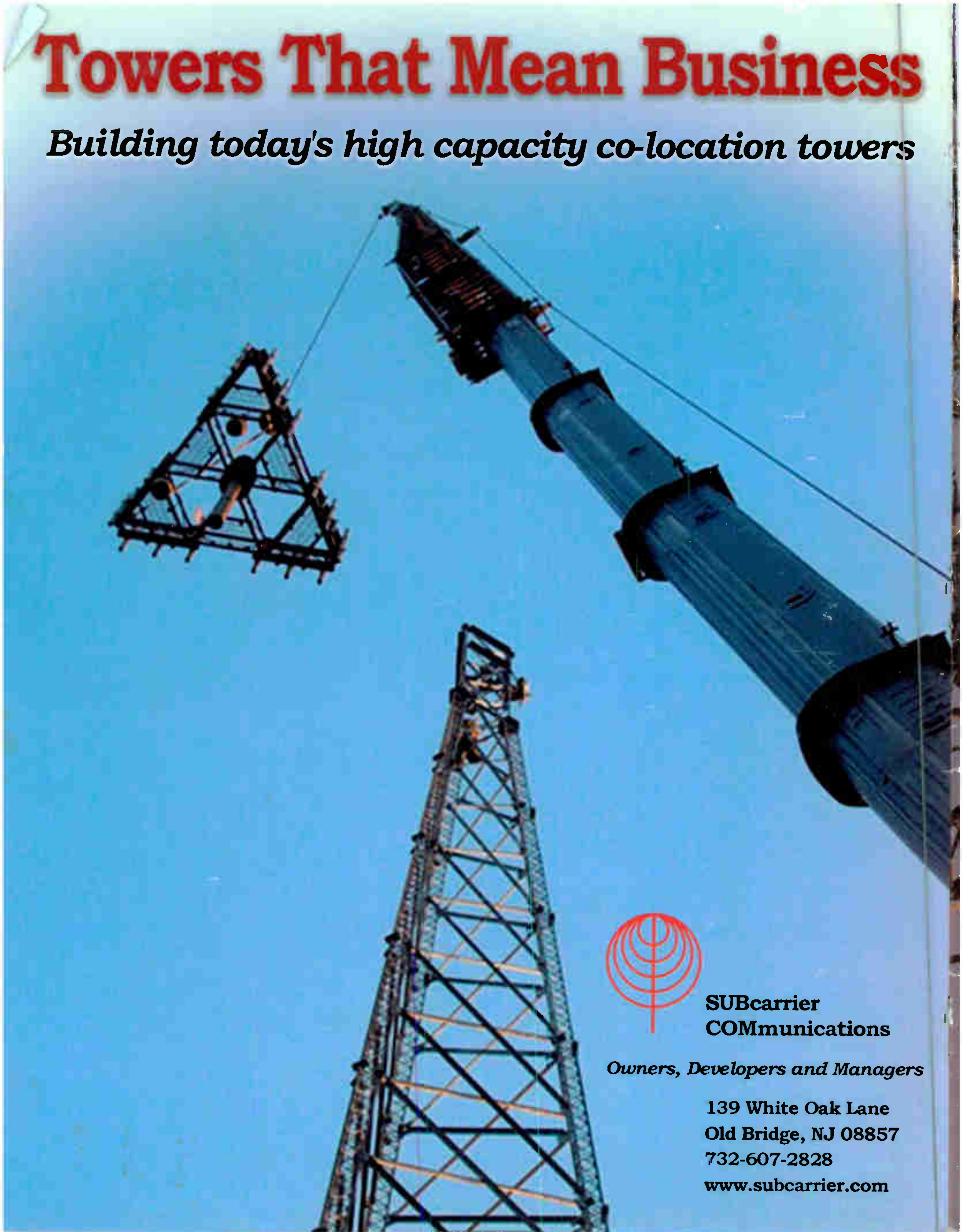
Public-safety 4.9 GHz antennas
The TA-4900 antenna series from **TIL-TEK** is designed specifically for the re-allocated 4.9 GHz band and consists of fixed sector base station, fixed omni directional, directional panel and parabolics antennas.
www.tiltek.com



Coaxial surge protectors for 1W to 1000 W, dc to 4 GHz
A new line of coaxial surge protectors for cellular and microwave systems, antennas, GPS and satellite systems has been launched by **Citel.** They are designed to provide fast-acting protection against lightning surges and electrical transients. The coaxial surge suppressors use a fast-acting, gas-tube technology suited for wireless/radio, meters, RTUs and broadband applications. Connectors types include: N, BNC, TNC, SMA and 7/16. The P8AX coaxial protectors are available for power uses from 1 W to 1,000 W and operating frequencies from dc to 4 GHz. Features include low VSWR and insertion loss. Grounding can be done either through an external ground screw or through a bulkhead mount. They can be mounted as a cable assembly or through the chassis of the equipment to be protected.
www.citelprotection.com



Diplexers for PCS/cellular overlay
Radio Frequency Systems has developed the next generation of FDGW diplexers for dual-band PCS/cellular networks. Designed to enable feeder-cable sharing between systems in the 806–960 MHz and 1,710–2,170 MHz ranges, the RFS FDGW5504/C series allows carriers to add new frequencies without additional cable runs. The FDGW5504/CN series diplexer is shielded by a polymer coating. Requiring no outer housing, it weighs less than three pounds. It is adaptable to wall, rack or pole mounting. Manufactured from a highly selective microstrip filter, the FDGW5504/C series provides a high level of isolation between its ports, while maintaining low insertion loss in both paths. High-performance peak power handling allows carriers to use multiple transmit frequencies at full power. By-pass options for full dc or just the high- or low-frequency bands make tower-mounted amplifier use optional.
www.rfsworld.com


Towers That Mean Business
Building today's high capacity co-location towers
SUBcarrier
COMmunications
Owners, Developers and Managers
139 White Oak Lane
Old Bridge, NJ 08857
732-607-2828
www.subcarrier.com